U.S. DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

PB86-910212

SELECTED WATER RESOURCES ABSTRACTS

MARCH 3, 1849

VOLUME 19, NUMBER 12
DECEMBER 1986

W86-05417 -- W86-06176
CODEN: SWRABW

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SELECTED
WATER RESOURCES
ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1987.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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01 NATURE OF WATER

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02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

POINT RAINFALL GENERATOR WITH INTERNAL STORM STRUCTURE,
Universite Libre de Bruxelles (Belgium). Center for Statistics and Operations Research.
J. L. Marien, and G. L. Vandewiele.
Water Resource Research WRERAO, Vol. 22, No. 4, p 475-482, April, 1986. 5 fig, 3 tab, 16 ref, 3 append.

Descriptors: *Hydrologic models, *Precipitation, *Rainfall, *Rainfall simulators, Storms, Model studies, Synthetic hydrology, Rainstorms, Prediction, Flood forecasting.

A point rainfall generator is a probabilistic model for the time series of rainfall as observed in one geographical point. The generator described in this paper is a continuous time model based on 13.5 years of 10-min point rainfalls observed in Belgium and digitized with a resolution of 0.1 mm. The generator attempts to model all features of the rainfall time series which are important for flood studies as accurately as possible. The original aspects of the model are 1) the way in which storms are defined and 2) the theoretical model for the internal storm characteristics. The storm definition has the advantage that the important characteristics of successive storms are fully independent and precisely modelled, even on time bases as small as 10 min. The model of the internal storm characteristics has a strong theoretical structure, which justifies better the extrapolation of this model to severe storms for which the data are very sparse. This can be important when using the model to simulate severe flood events. (Cassar-PTT)
W86-05427

PARAMETER UNCERTAINTY IN ESTIMATION OF SPATIAL FUNCTIONS: BAYESIAN ANALYSIS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
P. K. Kitanidis.
Water Resources Research WRERAO, Vol. 22, No. 4, p 499-507, April, 1986. 21 ref, 2 append.

Descriptors: *Hydrologic models, *Bayesian analysis, *Stochastic processes, *Spatial distribution, *Parametric hydrology, Rainfall, Transmissivity, Fate of pollutants, Model studies, Mathematical studies, Kriging.

Linear estimation has found many applications in the inference of spatial functions in surface and subsurface hydrology. The effect of parameter uncertainty is examined in a Bayesian framework with emphasis on the derivation of the Bayesian distribution (and its first two moments) of unknown quantities given some measurements. This distribution accounts not only for natural variability but also for parameter uncertainty. For known covariance parameters the Bayesian distribution (is Gaussian processes) with the mean being a given linear function of the data. This linear estimator is equivalent to the conventional Gaussian conditional mean estimator for a priori known drift coefficients. When both drift and covariance function parameters are uncertain, the Bayesian distribution is generally not Gaussian, and the Bayesian conditional mean is a nonlinear estimator. The case of diffuse priors is examined and it is shown that the posterior distribution of the convariance function parameters is given by the restricted likelihood function. The results provide insight into the applicability of maximum likelihood versus restricted maximum likelihood parameter estimation, and conventional linear versus kriging estimation. A more general procedure which include these methods as special cases is presented. (Cassar-PTT)
W86-05430

PROBABILITY PLOT CORRELATION COEFFICIENT TEST FOR THE NORMAL, LOGNORMAL, AND GUMBEL DISTRIBUTIONAL HYPOTHESES,
Tufts Univ., Medford, MA. Dept. of Civil Engineering.
R. M. Vogel.
Water Resources Research WRERAO, Vol. 22, No. 4, p 587-590, April 1986. 2 tab, 24 ref.

Descriptors: *Hydrologic models, *Statistical analysis, *Probability distribution, Filliben normality test, Looney-Gulledge normality test, Gumbel distribution, Correlation coefficient, Normality tests, Mathematical studies.

A new probability plot correlation coefficient test was developed for the Gumbel distribution. Critical points of the test statistics are provided for samples of length 10 to 10,000. Two previously developed tests were originally developed for testing the normal hypothesis for sample sizes <100. Since many water resource research applications require a test of normality for samples of length 100 to 10,000. The PPCC test statistic does not depend on the procedure employed to estimate the parameters of the probability distribution. (Cassar-PTT)
W86-05439

POTENTIAL WATER YIELD IN SEMIARID REGIONS,
Ministry of Water Resources and Development, Harare (Zimbabwe).
T. B. Mitchell.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 37-47, 4 fig, 1 tab, 5 ref, 1 append.

Descriptors: *Rainfall-runoff relationships, *Water yield, *Reservoir, *Water resources development, Semiarid lands, Zimbabwe, Evaporation, Runoff, Developing countries, Water storage, Storage, Potential water supply, Statistical methods, Markov Process, Dams.

Efficient water resource planning in developing countries, such as Zimbabwe, requires not only an estimate of the mean annual runoff (MAR) and the coefficient of variation of a particular river system but also some method of assessing the expected annual yield from the system. The concept of the theoretical potential yield is developed. The potential yield is a function of the MAR, the coefficient of variation and the total volume of water that can be stored. In semiarid regions, evaporation from reservoir surfaces can absorb a significant part of the MAR. Curves are presented for estimating the potential yield of a system. These have been calculated using the transition probability matrix method based on the Markov process. This theoretical potential yield is the first approximation to the total amount of surface water that can be developed within a river system. Simple rules are also presented for determining the yields from combinations of dams and the potential yield can be modified as these dams are constructed. (See also W86-05750) (Author's abstract)
W86-05754

PHYSICAL MODELING OF RESERVOIR HYDRODYNAMICS,
Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
M. S. Dortch, S. C. Wilhelms, and J. P. Holland.
Final Report. Technical Report E-85-14, December 1985. 82 p, 18 fig, 4 plates, 31 ref, 2 append.

Descriptors: *Physical modeling, *Reservoirs, *Hydrodynamics, Density currents, Navier-Stokes equations, Mathematical studies, Froude numbers, Reynolds numbers, Model studies.

Guidance is presented for the use of physical models in the study of reservoir hydrodynamic processes. Modeling theory is developed by nondimensionalizing the Navier-Stokes equations of fluid motion. Examination of these nondimensional equations shows that complete dynamic similitude between prototype and model is achieved by the equating of respective Froude and Reynolds numbers. Although such an equation is not possible if water is the model and prototype fluid, similitude is still maintained if the model and prototype Froude numbers are equated and if the fundamental character of prototype flow (turbulent) is maintained in the model. Scaling relationships for undistorted and distorted models are presented and the appropriate use of each is discussed. Examples of the application of the relationships presented are: 1) selected withdrawal research, 2) the Dickey-Lincoln School Lakes Model, 3) Reservoir destratification, and 4) Marysville Lake Hydrothermal Study. An extensive list of publications documenting site-specific and research investigations involving physical modeling is also provided in the bibliography. (Lantz-PTT)
W86-05806

LARGE BASIN DETERMINISTIC HYDROLOGY: A CASE STUDY,
San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-05860

RUNOFF PROBABILITY, STORM DEPTH, AND CURVE NUMBERS,
Utah State Univ., Logan. Dept. of Forest Resources.
R. H. Hawkins, A. T. Hjelmfelt, and A. W. Zevenbergen.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 111, No. 4, p 330-340, December 1985. 5 fig, 5 tab, 14 ref.

Descriptors: *Storm depth, *Storm runoff, *Rainfall-runoff relationships, Antecedent moisture, Runoff, Mathematical analysis.

Probabilistic interpretations of the antecedent moisture condition (AMC) in the curve number method, and to apply the results to the problem of determining curve numbers from rainfall-runoff data. Conversions through three moisture conditions - AMC I, AMC II, and AMC III - where condition II is the benchmark situation upon which a watershed is described, and conditions I and III are the 'dry' and 'wet' situations. Using existing AMC Curve Number relationships, a general expression of rainfall-runoff is developed for AMC I and AMC III. The probability distribution of event runoff exceeding zero is found to be lognormal. Relative storm size is then proposed to be defined on the ratio rainfall depth/curve number (P/S), where a 'large' storm has P/S > 0.46, when 90% of all rainstorms will create runoff. Consequent problems arising in the definition of CN from rainfall-runoff data are discussed. (Doria-PTT)
W86-05917

ROUGHNESS COEFFICIENTS FOR ROUTING SURFACE RUNOFF,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
E. T. Engman.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 1, p 39-53, February 1986. 2 fig, 7 tab, 28 ref.

Descriptors: *Roughness coefficient, *Surface runoff, *Rainfall-runoff relationships, *Hydraulic roughness, Channel morphology, Rainfall rate, Rainfall simulators, Erosion, Simulation analysis.

Hydraulic roughness coefficients have been derived from runoff plot data originally collected for erosion studies. The data were collected from different agricultural and natural surfaces by applying constant rainfall rates from rainfall simulators. The derived roughness coefficient is actually an 'effective' roughness coefficient that includes: the effect of raindrop impact; the effect of channelization of flow; the effects of obstacles such as litter, crop ridges, rocks, and roughness from tillage; the frictional drag over the surface; and the erosion and transport of sediment. A ready reference of friction factors for overland flow is presented in tabular format with a description of the various surfaces and land uses. Surface conditions varied from very smooth asphalt to extremely rough, litter-strewn

agricultural and rangeland areas. (Author's abstract)
W86-05926

ERRORS IN STORMWATER MODELING - A QUANTITATIVE ASSESSMENT,

National Water Research Inst., Burlington (Ontario).
W. Schilling, and L. Fuchs.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 112, No. 2, p 111-123, February 1985, 10 fig, 15 ref.

Descriptors: *Model studies, *Storm runoff, *Flood routing, *Rainfall-runoff relationships, Surface runoff, Surface flow, Loss rate, Design storms, Hydrographs, Routing.

The accuracy of stormwater modeling was estimated with emphasis on modeling errors in peaks and volumes. A rainfall-runoff model which features rainfall with high spatial resolution and time-varying loss rates was developed. Twenty-seven rainfall events, obtained from high resolution radar measurements in the Munich area, were applied to a hypothetical 729 ha catchment using this model. Simulation results indicate that the spatial resolution of rain data input is of the most importance to the accuracy of the simulated hydrograph because of: 1) the high spatial variability of storms and 2) the amplification of rainfall sampling errors by the nonlinear transformation into runoff. (McFarlane-PTT)
W86-05985

TIME SERIES MODELING OF COASTAL CURRENTS,

Middle Georgia Coll., Cochran. Dept. of Mathematics.
For primary bibliographic entry see Field 2G.
W86-06113

2B. Precipitation

MESOSCALE FREQUENCIES AND SEASONAL SNOWFALLS FOR DIFFERENT TYPES OF LAKE MICHIGAN SNOW STORMS,

Chicago Univ., IL. Dept. of Geophysical Sciences.
R. D. Kelly.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 3, p 308-312, March 1986. 6 fig, 2 tab, 7 ref. NSF Grant No. NSF-ATM-8310429.

Descriptors: *Mesoscale storms, *Snow, *Lake Michigan, *Snow surveys, *Cloud physics, Satellite technology, Remote sensing, Weather satellites.

Members of the Cloud Physics Laboratory, University of Chicago, have identified three different mesoscale organization patterns of lake-effect snow storms over Lake Michigan: multiple wind-parallel bands, single midlake bands, and single shoreline bands. For the 70 snowfall seasons ending with 1980/81, it was estimated that lake-effect snows contributed 8% to the total snowfall along the west shore of the lake, and 39% along the east shore. In the present study, daily GOES satellite images and daily snowfall records are used to calculate the seasonal snowfall in four geographical areas from each type of lake-effect, and non-lake-effect storm, for the snowfall season 1978/79 and 1979/80. Over the two seasons, 176 snowfall days were identified. Of these, 52% were nonlake-effect and 48% were lake-effect days. Of the 84 lake-effect days, 51% had wind-parallel bands, 22% had midlake bands, 2% had shoreline bands, and 25% had undetermined lake-effect cloud types. Along the west shore of the lake, lake-effect snows contributed 29% of the total snowfall, primarily from midlake bands. Along the east shore, lake-effect storms contributed 50% of the total snowfall. About half of the lake-effect contribution on the east shore was from wind-parallel bands, with most of the remainder from midlake bands and undetermined convective types. Although individual shoreline bands may yield locally heavy snowfalls, their contribution in 1978/79 and 1979/80 was very small, probably due to their low frequency of occurrence and the localized nature of their snowfall. (Lantz-PTT)
W86-05417

POINT RAINFALL GENERATOR WITH INTERNAL STORM STRUCTURE,

Universite Libre de Bruxelles (Belgium). Center for Statistics and Operations Research.
For primary bibliographic entry see Field 2A.
W86-05427

CONTINUOUS-TIME VERSUS DISCRETE-TIME POINT PROCESS MODELS FOR RAINFALL OCCURRENCE SERIES,

Washington Univ., Seattle. Dept. of Civil Engineering.
E. Foufoula-Georgiou, and D. P. Lettenmaier.
Water Resources Research WRERAO, Vol. 22, No. 4, p 531-542, April 1986. 6 fig, 3 tab, 32 ref.

Descriptors: *Precipitation, *Rainfall, Rainfall distribution, Model studies, Neyman-Scott process, Poisson distribution, Markov process, Bernoulli process, Mathematical studies, Hydrology.

If rainfall occurrences are interpreted as the events of a point process (and not as a censored sample), the continuous-time point process methodology and estimation procedures are not directly applicable. This is demonstrated analytically by studying the effects of discretization on selected statistical properties of a Poisson process, a Neyman-Scott process, and a renewal Cox process with Markovian intensity. Previous studies have failed to account for time discreteness and have followed a continuous-time point process framework, producing severe biases in estimation and misleading interpretations regarding rainfall clustering. It is suggested that rainfall occurrences should be compared with the discrete-time independent Bernoulli process and not with the continuous-time Poisson. For example, daily rainfall occurrence structure that are underdispersed relative to the Poisson process are usually overdispersed relative to the Bernoulli process. Six daily rainfall records representative of a range of U.S. climates were used to confirm these findings. (Cassar-PTT)
W86-05433

CHARACTERISTICS AND DISTRIBUTION OF CLOUD WATER OVER THE MOUNTAINS OF NORTHERN COLORADO DURING WINTERTIME STORMS. PART 1: TEMPORAL VARIATIONS,

Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
R. M. Rauber, and L. O. Grant.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 4, p 468-488, April 1986. 19 fig, 17 ref.

Descriptors: *Supercooling, *Orographic precipitation, *Storms, Colorado, Rocky mountains, Winter, Precipitation rate, Temporal variations, Cloud liquid water.

The temporal variations of the supercooled water field during ten wintertime storms occurring over the northern Colorado Rockies were examined. The prefrontal convective regions, prefrontal stratiform cloud systems, postfrontal stratiform and convective systems and orographic clouds are discussed. The radiometric measurements were supported by simultaneous measurements of liquid water at mountaintop, ice crystal rime measurements at high and low altitude sites, radar measurements of cloud echo top height and cloud reflectivity, rawinsonde measurements, and specially collected precipitation intensity measurements. The ten case studies represent various stages in the synoptic scale evolution of storms that affect the region. Liquid water occurred in nearly all stages of most of these storms. The temporal variations in the magnitude of the liquid water content were significant. In the prefrontal cloud system three common features concerning the evolution of the liquid water field were observed: an inverse relationship between precipitation rate and liquid water content; a direct relationship between cloud top temperature and liquid water content; and the magnitude of the liquid water content was consistently higher over the mountain slopes. In the postfrontal cloud system the liquid water content varied slightly upwind of the mountain base but varied considerably in the vicinity of the mountain. The magnitude of the liquid water content over the ridge was inversely related to the precipitation rate at mountain base. Liquid water production near the ridgeline was associated with orographic and convective forcing. The three orographic cloud systems that were studied were shallow, had tops warmer than -22 degrees C, and had limited horizontal extent. The changes in the liquid water field were inversely associated with changes in precipitation rate. In one case, a decrease in liquid water content was also associated with a decrease in cloud top temperature. (Peters-PTT)
W86-05456

CHARACTERISTICS AND DISTRIBUTION OF CLOUD WATER OVER THE MOUNTAINS OF NORTHERN COLORADO DURING WINTERTIME STORMS. PART II: SPATIAL DISTRIBUTION AND MICROPHYSICAL CHARACTERISTICS,

Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
R. M. Rauber, and L. O. Grant.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 4, p 489-504, April 1986. 2 tab, 14 fig, 21 ref.

Descriptors: *Cloud liquid water, *Mountains, *Supercooling, Colorado, Rocky mountains, Clouds, Orography, Stratiform systems, Fluid drops, Spatial distribution.

Airborne and ground-based measurements were used to examine the characteristics of supercooled water fields. Conceptual models of the supercooled water fields in three general cloud systems that occur over the Park Range of the northern Colorado Rockies were constructed. They were compared to conceptual models developed during previous studies in other locations in the western United States. Cloud top, cloud base, and zones of strong orographic lift were identified as regions in stratiform systems where supercooled water production can occur. Cloud systems over the Park Range were found to have low droplet concentrations. Broad droplet spectra were consistently observed in clouds with the lowest droplet concentration. Significant numbers of large droplets were present in these cases. (Peters-PTT)
W86-05457

INTERSTATION CORRELATIONS AND NONSTATIONARITY OF BURKINA FASO RAINFALL,

Groningen Univ. (Netherlands). Econometrics Inst.
T. A. B. Snijders.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 4, p 524-531, April 1986. 1 tab, 10 fig, 17 ref.

Descriptors: *Rainfall rate, *Correlation analysis, *Burkina *Burkina Faso, *Seasonal variation, Africa, Nonstationarity.

The rainfall regime of central and northern Burkina Faso were examined for 1923-1983. Interstation correlations and (non-)stationarity were studied for several rainfall indicators. The seasonal rainfall totals for interstation correlations were low. Sums of truncated daily rainfall values, with the number of rainy days as an extreme case, exhibited larger interstation correlations. An explanation is that factors determining the occurrence of rainfall in West Africa operate on a larger scale than those determmining exact rainfall amounts. A new method is proposed for constructing regional rainfall indices from data for several locations in the presence of missing data. the method is applied in a study of (non-) stationarity of Burkina Faso rainfall. There is a significant departure of stationarity, which is especially expressed in earlier dates for the end of the rains, and smaller average rain-

fall amounts per day between the start and the end of the rains. (Peters-PTT)
W86-05458

MESOSCALE INDEXING OF THE DISTRIBUTION OF OROGRAPHIC PRECIPITATION OVER HIGH MOUNTAINS,

Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.
P. Alpert.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 4, p 532-545, April 1986. 3 tab, 10 fig, 20 ref.

Descriptors: *Orographic precipitation, *Mountains, *Advection, Himalayas, Equador, Andes, Sierra Nevada mountains, Precipitation model, Atmospheric physics, Model studies.

The mesoscale indexing of the distribution of orographic precipitation rates was studied. The precipitation rate estimates were based on the assumption that the orographic precipitation approximately equals the convergence of moisture in the mountainous boundary layer. Results were compared with previous case studies. Realistic precipitation distributions were obtained when numerical advection was permitted for the Himalayas, Equadorian Andes, and the Sierra Nevada Mountains in California. In the latter case the simulated distributions competed well with a fully two-dimensional precipitation model for some unusual storm events. For the distribution of precipitation over the high mountains the detailed microphysical processes may play a lesser essential role than that for small to medium size mountains. An upper limit for elevation of maximum orographic precipitation exists, which is independent of the mountain height and determined mainly by the moisture scale height and the tropospheric scale height. In addition to the two maximum of precipitation over the Himalayas that have been observed in the foothills and at about 2-2.4 km, a third unknown maximum is predicted by the theory. This unobserved maximum is predicted over the Great Himalayan Range at the height of 4 km. Such a maxima could not be detected due to the lack of enough observations at high elevations. (Peters-PTT)
W86-05459

FURTHER ASSESSMENT OF TREATMENT EFFECTS IN THE FLORIDA AREA CUMULUS EXPERIMENT THROUGH GUIDED LINEAR MODELING,

Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 3B.
W86-05460

PRECIPITATION ANOMALY CLASSIFICATION: A METHOD FOR MONITORING REGIONAL PRECIPITATION DEFICIENCY AND EXCESS ON A GLOBAL SCALE,

National Environmental Satellite, Data, and Information Service, Washington, DC. Climate Analysis Center.
J. E. Janowiak, C. F. Ropelewski, and M. S. Halpert.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 4, p 565-574, April 1986. 2 tab, 7 fig, 5 ref.

Descriptors: *Drought, *Precipitation, *Moisture index, Palmer drought severity index, Crop moisture index, Australia, Monitoring.

The modification and implementation of a technique, developed by the Australian Bureau of Meteorology, which requires monthly accumulated precipitation observations are described. The technique identifies and tracks significant global precipitation anomalies, and requires long term (20 or more years) monthly precipitation histories. Tests indicate that the technique compares favorably with the well-known Palmer Drought Severity Index and Crop Moisture Index in the United States. Since monthly precipitation data are readily available in a near real-time framework, this method makes an automated, global precipitation anomaly monitoring system possible. (Peters-PTT)
W86-05461

RELATIONSHIP BETWEEN INDIAN SUMMER MONSOON RAINFALL AND LOCATION OF THE RIDGE AT THE 500-MB LEVEL ALONG 75 DEGREES E,

Indian Inst. of Tropical Meteorology, Poona.
D. A. Mooley, B. Parthasarathy, and G. B. Pant.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 5, p 633-640, May 1986. 2 tab, 5 fig, 35 ref.

Descriptors: *Monsoons, *Rainfall intensity, *Seasonal variation, India, Regression analysis, Geography.

The relationship between all-India/subdivisional monsoon rainfall and the 500-mb ridge location was studied. The error of the estimates rainfall for 10 independent years was investigated. The smallest length of the period (10, 15, 20 years) for which the relationship is stable and consistently significant was determined. Regression equations were developed for the latest period. The subdivisions of India where monsoon rainfall is significantly related to the ridge location were examined. The contingency table for the two parameters shows that when the ridge is south of the mean position to more than one standard deviation, all-India rainfall is deficient on 80% of such occasions and that when the ridge is located to the north of the mean, all-India rainfall is excessive on two-thirds of such occasions. The regression equation between all-India monsoon rainfall and the ridge locations explains about 53% of the total variance. The ridge location appears to be the only single parameter that explains such a high percentage. The southernmost ridge location was 11 degrees N and the northernmost, about 18 degrees N. The variation of 7 degrees in the latitude of the ridge location over western penisular India during April makes a large difference in all-India monsoon rainfall. The ridge locations with relatively high departures from the normal in April might have a tendency to persist, resulting in early or delayed transition to the tropospheric conditions from premonsoon season to the monsoon season. (Peters-PTT)
W86-05462

THREE-DIMENSIONAL CLOUD CHEMISTRY MODEL,

McGill Univ., Montreal (Quebec). Dept. of Meteorology.
For primary bibliographic entry see Field 5B.
W86-05463

RELATIONSHIPS FOR DERIVING THUNDERSTORM ANVIL ICE MASS FOR CCOPE STORM WATER BUDGET ESTIMATES,

National Center for Atmospheric Research, Boulder, CO.
A. J. Heymsfield, and A. G. Palmer.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 5, p 691-702, May 1986. 4 tab, 10 fig, 18 ref.

Descriptors: *Thunderstorms, *Precipitation, *Clouds, *Radar, Ice water content, Montana, Convective precipitation, Mathematical analysis.

Relationships are derived for estimating the ice water content of the anvil regions of clouds sampled with aircraft in Montana during the 1981 Cooperative Convective Precipitation Experiment (CCOPE). An approach which minimized the error in converting measured crystal size to mass was used, but other sources of error exist, especially when measurements are taken in the vicinity of convective cells. The effects of truncation of the measured size spectrum due to sampling volume limitations are discussed. Ice water content values predicted from the curves are the same for a given value of the radar reflectivity. Derived curves differ in some cases from those applied to thunderstorm anvils in the past. A sensitivity study was performed to develop an improved mass-diameter relationship for anvil crystals. The choice of Z-ice water content relationship has a major effect upon the estimate of the mass transported into the anvil, as demonstrated from use of the cases where wind-fields were measured using Doppler radar. (Peters-PTT)
W86-05464

ATMOSPHERIC WATER BALANCE OVER A MOUNTAIN BARRIER,

Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
E. E. Hindman.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 2, p 180-183, February 1986. 2 fig, 1 tab, 8 ref. NSF ATM-84-07543, USAF Contract F19628-84-C-005.

Descriptors: *Precipitation, *Park range, *Colorado, *Snowfall augmentation, *Hydrologic budget, Box model, Mathematical model, Front range, Winter, Air circulation, Snow management, Orography.

The flow of moisture through a 'slab' of air, upwind, and over the Park Range in northwestern Colorado, was estimated from winter meteorological measurements and an order of magnitude water balance of wintertime orographic clouds was produced using a box model. On average, 6-14% of the inflow moisture precipitated onto the barrier (86-94% flowed over the barrier). Because such a small amount of the moisture precipitates, snowfall augmentation activities on the upwind Park Range barrier should not significantly affect the moisture reaching the downwind Front Range barrier. To improve these estimates measurements are required of the vertical distribution of the liquid water and ice water between the barrier crest and the cloud tops. (Rochester-PTT)
W86-05474

GRID HISTORY: A GEOSTATIONARY SATELLITE TECHNIQUE FOR ESTIMATING DAILY RAINFALL IN THE TROPICS,

Wisconsin Univ.-Madison. Space Science and Engineering Center.
D. W. Martin, and M. R. Howland.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 2, p 184-195, February 1986. 7 fig, 5 tab, 29 ref, append. NSF-grant ATM 7920850, NASA grant NA-80-SAC-00742, NASA grant NA-84-DGC-00240.

Descriptors: *Geostationary satellite, *Rainfall estimation, *Tropics, *Visible imagery, *Infrared imagery, *Remote sensing, South China Sea, India, Arabian Sea, Grid history, North Atlantic Ocean, Amazonia, Least squares method, Multivariate linear regression.

A new technique for estimating daily rainfall by means of visible and infrared geostationary satellite imagery which is designed for the tropics and warm-season midlatitudes, operates on a grid of points and measures time changes at these points, and is therefore called 'grid history.' It is assumed that, at any grid point in some image belonging to a sequence, by means of spectral, textural and evolutionary information, it is possible to classify instantaneous rain as nil, light, moderate, or heavy. The total rainfall over a day is the sum over three classes of the product of frequency and class average rate. Class average rates were determined by least-squares multivariate linear regression of frequencies on observed rainfalls in the following areas: South China Sea, India, Arabian Sea, tropical North Atlantic Ocean, and Amazonia. Inland India had the lowest (driest) class average rates (coefficients) and coastal India had the largest (wettest) coefficients. For the strongly convected rain regimes treated here, it was important to 'look' at the area at least once per hour. A loss of accuracy in estimates over land apparently was due to unexpectedly large terrain and synoptic effects. Best-circumstance estimates of daily rainfall for an area 100 km on a side should be within a factor of 2 for true rainfall. (Rochester-PTT)
W86-05475

CORRELATIONS BETWEEN NIMBUS-7 SCANNING MULTICHANNEL MICROWAVE RADI-

OMETER DATA AND AN ANTECEDENT PRECIPITATION INDEX,

Texas A and M Univ., College Station. Dept. of Meteorology.
G. D. Wilke, and M. J. McFarland.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 2, p 227-238, February 1986. 13 fig, 4 tab, 16 ref. NASA Agristars Program Contract NAS 9-16822.

Descriptors: *Satellite technology, *Microwaves, *Radar, *Great Plains, *Antecedent precipitation index, Soil water, Agricultural areas, United States, Linear regression analysis, Surface air temperature, Transforms, Precipitation, Remote sensing.

Passive microwave brightness temperatures from the Nimbus-7 Scanning Multidimensional Microwave Radiometer (SMMR) can be used to infer the soil moisture content over agricultural areas such as the southern Great Plains of the United States. A linear regression analysis between three transforms of the five dual polarized SMMR wavelengths of 0.81, 1.36, 1.66, 2.80, and 4.54 cm and antecedent precipitation index representing the precipitation history showed correlation coefficients greater than 0.90 for pixel aggregates of 25-50 km. The use of surface air temperatures to approximate the temperature of the emitting layer was not required to obtain higher correlation coefficients between the transforms and the antecedent precipitation index. (Author's abstract)
W86-05476

DETERMINATION OF THE LATENT HEAT FLUX IN FOG,

Istituto di Fisica dell'Atmosfera, Rome (Italy).
M. Severini, G. Tonna, M. L. Moriconi, and B. Olivieri.
Atmosperic Environmental ATENBP, Vol. 20, No. 2, p 397-400, February 1986. 3 fig, 2 tab, 5 ref.

Descriptors: *Latent heat flux, *Fog, *Fog density, *Surface heat balance equation, Po Valley, Italy.

The latent heat flux was determined during a fog event (a 4-day fog at San Pietro Capofiume micrometeorological station, in the eastern Po Valley, North Italy) using a method based on the surface heat balance equation and a parameterization of the sensible heat flux using the Kazanskiy-Molin model. The computed values of the latent heat flux show that it is connected with fog density. It is concluded that it is possible to determine the latent heat flux due to fog formation with sufficient accuracy to give estimates of periods of fog thickening and thinning. (Rochester-PTT)
W86-05497

TECHNICAL NOTE: EXPERIMENTAL DETERMINATION OF THE CALCIUM CARBONATE SATURATION STATES OF WATER SYSTEMS,

Environmental Science and Engineering, Inc., Gainesville, FL.
For primary bibliographic entry see Field 5B.
W86-05513

RECENT HEAVY PRECIPITATION IN THE VICINITY OF THE GREAT SALT LAKE: JUST HOW UNUSUAL,

National Climatic Center, Asheville, NC.
For primary bibliographic entry see Field 2H.
W86-05550

OROGRAPHIC VARIATION OF PRECIPITATION IN A HIGH-RISE HIMALAYAN BASIN,

Roorkee Univ. (India). Dept. of Civil Engineering.
A. K. Bagchi.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 3-5, 4 fig, 6 ref.

Descriptors: *Hydrologic aspects, *Hydrologic budget, *Watersheds, *Alpine regions, Mountains, Orography, Precipitation, Orographic precipitation, Snow, Rainfall, Discharge hydrographs, Himalaya, Beas River.

Methods for determining changes in the form of precipitation with altitude, and orographic variation of precipitation in order to predict streamflow, are discussed. The experimental basin is described, and the assumptions and mathematical considerations for predicting form of precipitation and orographic increases are outlined. The methods of verification involve indirect techniques because no direct measurements of the precipitation (minus evapotranspiration) exist anywhere in the Himalaya. Using the calculations derived in this study, the discharge in the River Beas was determined for a 90-day period. (See also W86-05610) (Halterman-PTT)
W86-05611

CHARACTERISTICS OF PRECIPITATION DURING THE MONSOON SEASON IN HIGH-MOUNTAIN AREAS OF THE NEPAL HIMALAYA,

Nagoya Univ. (Japan). Water Research Inst.
K. Higuchi, Y. Ageta, T. Yasunari, and J. Inoue.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 21-30, 7 fig, 13 ref.

Descriptors: *Hydrologic aspects, *Hydrologic budget, *Watersheds, *Alpine regions, Mountains, Orography, Precipitation, Orographic precipitation, Snow, Rainfall, Discharge hydrographs, Himalaya, Glaciers, Glaciohydrology, Nepal, Dodh Kosi.

Precipitation phenomena during some summer monsoon seasons were observed in high-mountain areas of the Nepal Himalaya. The main results obtained from these observations are as follows: (a) Precipitation along the main valley of Dudh Kosi decreases with altitude in the range from 2800 m to 4500 m; (b) The total amount of precipitation around peaks and ridges is 4 or 5 times larger than that around valley bottoms; (c) The frequency and amount of precipitation around peaks and ridges are concentrated during the day-time when cumulus convection is predominant, while those around valley bottoms are concentrated during the evening up to midnight; and (d) A linear relation between the surface air temperature and the percentage of occurences of snowfall to all cases of precipitation was obtained from the observations at the station (4958 m) near Glacier AXOLO in Shorong Himal. (See also W86-05610) (Author's abstract)
W86-05613

INVESTIGATIONS OF THE HYDROLOGICAL CONDITIONS OF ALPINE REGIONS BY GLACIOLOGICAL METHODS,

Akademiya Nauk SSSR, Moscow. Inst. Geografii.
For primary bibliographic entry see Field 2C.
W86-05614

HYDROLOGICAL ASPECTS OF THE GLACIER REGIME IN THE NORTH TIEN SHAN IN THE ANOMALOUSLY ARID PERIOD OF 1974-1978,

Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Sektor Fizicheskoi Geografii.
For primary bibliographic entry see Field 2C.
W86-05615

PRECIPITABLE WATER: ITS LINEAR RETRIEVAL USING LEAPS AND BOUNDS PROCEDURE AND ITS GLOBAL DISTRIBUTION FROM SEASAT SMMR DATA,

Jet Propulsion Lab., Pasadena, CA.
P. C. Pandey.
Available from the National Technical Information Service, Springfield, VA. 22161, as N83-17992, Price codes: A03 in paper copy, A01 in microfiche. JPL Publication 82-96, December 1, 1982. 25 p. 5 fig, 6 tab, 22 ref, 1 append.

Descriptors: *Precipitation, *Distribution patterns, *Microwaves, *Radiometry, Linear retrieval, Regression analysis, Atmospheric water, Satellite technology, Seasat, Maps.

The Seasat Scanning Multichannel Microwave Radiometer (SMMR) measurements in the 18.0, 21.0, and 37.0 GHz channels are primarily used for precipitable water (also known as atmospheric water vapor content) and liquid water determination. Linear regressions using a leaps and bounds procedure are used for the retrieval of precipitable water. A total of eight subsets using two to five frequencies of the SMMR are examined to determine their potential in the retrieval of atmospheric water vapor content. Our analysis indicates that the information concerning the 18 and 21 GHz channels are optimun for water vapor retrieval. A comparison with radiosonde observations gave a root mean square accuracy of 0.40 g/sq cm. The root mean square accuracy of precipitable water using different subsets was within 10 percent. Global maps of precipitable water over oceans using two and five channel retrieval (average of two and five channel retrieval) on a monthly basis for the period 7 July - 6 August 1978. An analysis of these global maps reveals the possibility of global moisture distribution associated with oceanic currents and large scale general circulation in the atmosphere. A stable feature of the large scale circulation is noticed. The precipitable water is maximum over the Bay of Bengal and in the North Pacific over the Kuroshio current and shows a general latitudinal pattern. (Author's abstract)
W86-05742

PARAMETERIZATION SCHEME FOR CONVECTIVE CLOUD WATER AND CLOUD COVER,

Stockholm Univ. (Sweden). Meteorologiska Institutionen.
U. Hammerstrand.
Available from the National Technical Information Service, Springfield, VA. 22161, as N83-18187, Price codes: A02 in paper copy, A01 in microfiche. Report No. DM-40, August 1982. 33 p, 7 fig, 13 ref. Contract Nos. G-UR 2923-102 and G-GU 2923-104.

Descriptors: *Parametization, *Convective precipitation, *Convective cloud water, *Cloud cover, Forecast models, Model studies.

A parameterization scheme for convective cloud water and cloud cover is developed. A scheme is formulated to be used in conjunction with the scheme for 'penetrative convection.' It is implemented in a one-dimensional forecast model to perform experimental forecasts. The results from forecasts with different values on the parameters of the scheme are studied. The predicted heat, moisture, cloud cover and cloud water content depend on the choice of values of three unknown model parameters: (1) m sub r, the characteristic value of cloud water mixing ratio around which a cloud reaches a fully precipitating stage; (2) c sub o, the typical time-scale for the conversion of cloud drops to rain in a precipitating convective cloud; and (3) c sub d, the proportionality constant for diffusion and evaporation rate of cloud water. Additional experiments and evaluations of the results have to be done to find appropriate values on the parameters. However, the variations with height of the predicted variables seem to be qualitatively realistic. A few experiments have also been undertaken to compare forecasts with the new parameterization scheme to forecasts with the ordinary preventive convection scheme. (Lantz-PTT)
W86-05743

LONG PERIOD WEATHER RECORDS, DROUGHTS AND WATER RESOURCES,

Department of the Environment, London (England).
C. E. Wright, and P. D. Jones.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 89-100, 5 fig, 5 tab, 23 ref.

Descriptors: *Rainfall-runoff relationships, *Weather data collections, *Drought, *Data collections, *Reservoirs, Runoff, Evaporation, Forecasting, Maps, England, Ireland, Rainfall distribution, Wales.

Long, continuous rainfall records from 46 locations in the United Kingdom and Eire were critically analyzed to produce consistent data sets, compensating for the non-standard instruments and sites used throughout the years. The oldest data set began in 1697, four started in the 1700's, and the remainder originate in the mid 1800's. These records were analyzed to show their value in water resource studies and the assessment of drought characteristics. Analyses of rainfall and rainfall less actual evaporation were described for drought durations of 6-18 months, corresponding to periods most critical to the maintenance of water supplies from small and medium-sized reservoirs. Maps of rainfall distribution illustrate the areal variation in the extent of the most severe droughts during the past 130 years in England and Wales. Major droughts of 8-10 months duration occurred in 1887, 1921, 1929, and 1959. Major droughts of 16-18 months duration occurred in 1854-1855, 1869-1870, 1933-1934, and 1975-1976. It was concluded that greater use of long-term weather records could define more accurately the risks and uncertainties in water resources development and operation. (See also W86-05750) (Cassar-PTT)
W86-05759

INFLUENCE OF CLIMATIC VARIABILITY ON WATER RESOURCES IN JILIN PROVINCE, CHINA,

Jilin Province Inst. of Meteorological Science, Changchun (China).
D. Shicheng.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 185-192, 1 fig, 4 tab.

Descriptors: *Rainfall-runoff relationships, *Water demand, *Water management, Jilin Province, Siping, China, Climates, Agriculture, Runoff, Forecasting, Evaporation, Water supply.

Jilin province in northeastern china is subhumid with 1565 cu m/year runoff per capita. The limited water resources are unevenly distributed, and the rainfall is highly variable. The large population and the relatively large evaporation losses further aggravate the water supply problem. Agricultural production is more adversely affected by waterlogging than by lack of rain. Studies of correlation of crop production with climatic factors show a strong relationship with precipitation and the temperature from May to September (related to evaporation). Regional water shortages inhibit industrial and urban development in places such as Siping City. Climatic variability shows a more pronounced influence on runoff than on rainfall. An equation describes the ratio of percentage variation of runoff to that of rainfall in terms of annual evaporation and annual rainfall. A series of long-range rainfall and runoff forecasts were done in 1961. Accuracy of the rainfall forecasts is on the order of 65%. Runoff and consumption forecasts indicate that demands will be 30% of the runoff in a dry year by the year 2000. (See also W86-05750) (Cassar-PTT)
W86-05767

REAL TIME MANAGEMENT OF WATER RESOURCES IN LOW RAINFALL AREAS,

Indian Inst. of Tech., New Delhi. Dept. of Civil Engineering.
S. Chander, and A. Kumar.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 327-335, 6 tab, 4 ref.

Descriptors: *Conservation, *Water conservation, *Irrigation, *Water management, India, Semiarid lands, Forecasting, Rainfall, Model studies, Soil-water-plant relationships, Rainfall rate, Dynamics.

A methodology for determining irrigation needs for kharif irrigation (July-September) in India is presented. It considers the stochastic nature of the rainfall in this region of low rainfall. The method is illustrated using pearl millet as an example. Using 32 years of rainfall record, the crop yield is first calculated assuming that the rainfall is the only input and that no storage of water is provided. The mean yield is estimated as 0.297. By providing a storage of 69.5 mm/unit area and using the fixed operating rules based on average rainfall, the yield increases to 0.632. Two dynamic operating rules are evolved to save water without effecting the crop yield and to reallocate water to increase the yield per unit area. Using dynamic release rules, the average saving in water is 15.0 mm/unit area (22%). In this case the yield reduces marginally to 0.616 maximum yield. On the other hand, reallocation of storage water based on forecast and use of the dynamic release rules, increases the crop yield marginally to 0.633 maximum yield. Conclusions of this study are that release of supplemental water based on the rainfall forecast improves the crop yield marginally. (See also W86-05750) (Cassar-PTT)
W86-05782

MODEL FOR ESTIMATING TIME-VARIANT RAINFALL INFILTRATION AS A FUNCTION OF ANTECEDENT SURFACE MOISTURE AND HYDROLOGIC SOIL TYPE,

Maryland Univ., College Park.
For primary bibliographic entry see Field 2G.
W86-05792

USE OF SATELLITE DATA IN RAINFALL MONITORING,

Bristol Univ. (England). Dept. of Geography.
E. C. Barrett, and D. W. Martin.
Academic Press, London, England. 1981. 340 p.

Descriptors: *Satellite technology, *Remote sensing, *Rainfall monitoring, *Meteorological data collection, Radar, Monitoring, Rainfall data, Hydrology, Climatology, Floods, Droughts, Clouds.

Rainfall is a vital meteorological element, yet our knowledge of this key environmental variable has been restricted by the inadequacies of data gained by conventional methods of monitoring. During the past 20 years, many methods have been suggested for the monitoring of rainfall by satellites, either independently, or in conjunction with the conventional methods of raingauge and radar. As this area of inquiry continues to expand rapidly, an urgent need has arisen for a considered and critical review of the state of current research and the directions it should be taking. This book attempts to synthesize and analyze the more promising methods in the field, while at the same time suggesting ways in which satellites might be used more effectively in rainfall monitoring in the future. The book opens with a survey of the problems encountered in current methods for monitoring the occurrence, rate, amount and distribution of rainfall, showing that improved rainfall data are needed. Also considered are which of the existing satellite systems may be capable of providing it. This is followed by a critical review of the birth of satellite rainfall monitoring methods and their growth and development, chiefly during the last decade. Primary uses of such methods in meteorology, climatology, hydrology and allied environmental sciences are discussed next. The book concludes with an examination of the prospects for obtaining still further improved satellite data in the future, especially through technological developments, improvements in interrelations between different types of observational networks, and better data processing and analysis. (Lantz-PTT)
W86-05802

HAPEX-MOBILHY: A HYDROLOGIC ATMOSPHERIC EXPERIMENT FOR THE STUDY OF WATER BUDGET AND EVAPORATION FLUX AT THE CLIMATIC SCALE,

American Meteorological Society, Boston, MA.
J.-C. Andre, J.-P. Goutorbe, and A. Perrier.
American Meteorological Society Bulletin, Vol. 67, No. 2, p 138-144, February 1986. 2 fig, 17 ref.

Descriptors: *HAPEX, *MOBILHY, *Hydrologic budget, *Evaporation, *Soil water, *Surface-energy budget, Remote sensing, Data base, Aircraft, Climates, Climatic data, Model studies.

The HAPEX (Hydrologic Atmospheric Pilot Experiment)-MOBILHY (Modelisation du Bilan Hydrique) program aims at studying the hydrologic budget and evaporation flux at the scale of a general circulation model grid square, i.e., 10,000 sq km. Different surface and subsurface networks will be operated during the year 1986, to measure and monitor soil moisture, surface-energy budget, and surface hydrology, as well as atmospheric properties. A 2.5-month special observation period will permit detailed measurements of atmospheric fluxes and intensive remote sensing of surface properties using well-instrumented aircraft. The main objective of the program, for which guest investigators are strongly encouraged, is to provide a data base against which parameterization schemes for the land-surface water budget will be tested and developed. This communication presents the scientific background for the study of the land-surface water budget in relation to climate modeling and a description of the objectives of HAPEX-MOBILHY and the experimental set-up of the program. (Rochester-PTT)
W86-05847

POWER OF A RAINSHOWER (PUISSANCE D'UNE AVERSE),

Institut Royal Meteorologique de Belgique, Brussels. Hydrology Section.
F. Bultot, and A. Coppens.
Hydrological Sciences Journal HSJODN, Vol. 30, No. 3, p 361-369, September 1985. 2 fig, 4 tab, 11 ref.

Descriptors: *Precipitation, *Rainfall impact, Rainfall, Rainfall Intensity, Mathematical equations, Mathematical analysis.

Based on the distribution of raindrops in space according to their size, the power of rainfall of various intensities was calculated. Keeping in mind the uncertainties inherent in the parameters, the corresponding values of the total rainfall energy do not differ significantly from those found with the simplified formulae currently used in erosivity indices. (Doria-PTT)
W86-05899

TRACKING A STORMY BEAST IN THE NIGHT,

R. A. Kerr.
Science SCIEAS, Vol. 29, No. 4716, p 848-849, August 30, 1985. 3 ref.

Descriptors: *Remote sensing, *Meteorology, *Satellite technology, *Thunderstorms, Mesoscale convective complex, Storms, Weather patterns, Weather forecasting, Storm formation.

Weather satellites have revealed thunderstorms organized into unexpectedly large nighttime rainstorms over the central United States. This newly recognized organization of thunderstorms is called a mesoscale convective complex (MCC). Compared to other kinds of summer thunderstorms, the rain from MCCs can be heavy, cover a large area, and go on for hours. They begin as typical convective systems during warm summer afternoons east of the Rockies, but then either expand or merge with other storms, often producing severe or damaging weather. MCCs tend to act like tropical storms, and may develop into tropical storms. Proposed mechanisms of MCC formation must be tested in models and against observations to facilitate their forecasting. (Doria-PTT)
W86-05905

ORIGINS AND TYPES OF RAINFALL IN WEST AFRICA,

Njala Univ. Coll., Freetown (Sierra Leone).
S. I. Kamara.
Weather WTHRAL, Vol. 41, No. 2, p 48-56, February 1986. 5 fig, 2 tab, 13 ref.

Descriptors: *Rainfall, *Orographic precipitation, *Monsoons, West Africa, Weather, Africa, Sahara, Thunderstorms, Cyclonic vortices, Convective Systems, Convergence.

Traditionally, rainfall is classified into the three main categories of Convectional, Cyclonic/Frontal and Relief /Orographic rainfall; according to the mechanism involved in the displacement of air and subsequent adiabatic cooling and condensation. In West Africa, this system of classifications is inadequate. There is no evidence of cyclonic or frontal activity in West Africa. Large amounts of rainfall are produced by atmospheric processes other than convection and orographic uplift. In some areas, over 50% of the total annual rainfall is derived from these extra sources. One basic feature of the lower atmosphere over West Africa during the rainy season (May to November) is the thermally-induced low pressure cell over the Sahara with its axis located between latitudes 18 deg North and 22 deg North. At the same time the Subtropical Anticyclone over the south Atlantic intensifies and extends towards the equator. The depth of the south-west monsoon decreases inland from the Guinea Coast. Above the south-west monsoon at a height of 3000 meters the winds assume a predominantly easterly component. The mid-tropospheric Africa Easterly Jet (AEJ) appears to originate from the strong horizontal temperature gradient between hot Sahara air and the relatively cooler, but still warm air of equatorial origin. The two main types of rain-producing convective systems in West Africa are the local convective rainstorm and linear rainstorms or line squalls. The amount of rainfall at any given location depends on the rate of airmass uplifting over the area. Mountain barriers can deflect, block or enhance air lift. Orographic rainfall in West Africa is localize, restricted to those areas where the land rises abruptly from the surrounding African plateau at a direction perpendicular to the south-westerly winds. The rainfall that is the result of the low level convergence includes rainfall due to large scale convergence and rainfall due to coastal convergence. The need exists for research into the atmospheric processes that produce rainfall, their nature and development, and their interaction with each other. (Peters-PTT)
W86-05953

MODELING OF RAINFALL EROSION,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W86-05971

COMPARING SOME METHODS OF ESTIMATING MEAN AREAL RAINFALL,

Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and P. K. Chowdhury.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 275-282, April 1986. 8 tab, 56 ref.

Descriptors: *Rainfall, *Areal precipitation, *Field tests, *Statistical analysis, *New Mexico, *River Ray, Great Britain, Finite element method, Analysis of variance, Mathematical models.

A comparison was made of 13 different methods of estimating mean areal rainfall on two areas in New Mexico and River Ray catchment, Great Britain. Daily, monthly, and yearly rainfall data were used. The 13 methods were: unweighted mean, grouped area aspect weighted mean, individual area weighted mean or Thiessen polygon, individual area altitude weighted mean, triangular area weighted mean, grouped mean weighted for distance and altitude (Myers method), isohyetal method, trend surface analysis (with linear function, quadratic function, and cubic function), reciprocal distance squared method, two-axis method, modified polygon method, finite element method, and analysis of variance. All methods, in general, yielded comparable estimates, especially for yearly values which suggests that a simpler method would be preferable for estimating mean areal rainfall in these areas. (Rochester-PTT)
W86-06022

MECHANISMS OF JAVA RAINFALL ANOMALIES,

Wisconsin Univ.-Madison. Dept. of Meteorology.
E. C. Hackert, and S. Hastenrath.
Monthly Weather Review, Vol. 114, No. 4, p 745-757, April 1986. 8 fig, 1 tab, 39 ref. NSF grants ATM82-00511, ATM84-1375.

Descriptors: *Atmospheric pressure, *Atmospheric circulation, *Rainfall, *Java, *Indian Ocean, *Southern oscillation, Monsoon, Indonesia, South China Sea, Bay of Bengal, Clouds, Wind, Seasonal distribution, Anomalies, Meridional pressure gradient.

The large-scale circulation departure patterns associated with the interannual variability of (July-June) rainfall in Java were studied on the basis of ship observations (1911-73) in the Indian Ocean and surface station records. Abundant rainfall years are characterized by an anomalously strong Northwest monsoon, and drought years by approximately inverse circulation characteristics. In December-January of the wet years, anomalously high pressure near Southeast Asia along with anomalously low pressure over Indonesia entail and enhance meridional pressure gradient, stronger northeasterly flow over the South China Sea and Bay of Bengal, and enhanced northwesterlies over the Indonesian waters. In May-October, anomalously low pressure, abundant cloudiness, and anomalous northwesterlies consistent with the enhanced pressure gradient are associated with a positive sea surface temperature anomaly in the Indonesian waters. By contrast, in November-April, abundant cloudiness and anomalous northwesterlies, again associated with anomalously low pressure but now resulting in higher wind speed, accompany a negative sea surface temperature anomaly. Anomalously low pressure and warm surface waters in May-October are followed by low pressure and low sea temperature in November-April, which in turn are succeeded by high May-October pressure. This seasonally varying relationship among cloudiness, wind, and sea surface temperature appears instrumental for the functioning of the Southern Oscillation. (Rochester-PTT)
W86-06051

ANATOMY OF A RAINFALL INDEX,

National Center for Atmospheric Research, Boulder, CO.
R. W. Katz, and M. H. Glantz.
Monthly Weather Review, Vol. 114, No. 4, p 764-771, April 1986. 3 fig, 2 tab, 25 ref.

Descriptors: *Rainfall index, *West African Sahel, *Brazilian northeast, *Drought, *Arid regions, *Semiarid regions, Standardized anomaly index, Principal component analysis, Statistical analysis, Social adjustment.

One index commonly has been used to monitor precipitation in drought-prone regions such as the West African Sahel and the Brazilian Northeast. The construction of this index involves standardizing the annual total rainfall for an individual station and then averaging these standardized rainfall deviations over all the stations within the region to obtain a single value. Some theoretical properties of this 'Standardized Anomaly Index' are derived. By studying its behavior when applied to actual rainfall data in the Sahel, certain aspects of the practical utility of the index are also considered. For instance, the claim that the Sahel has recently experienced a long run of relatively dry years does not appear to be sensitive to the exact form of index that is employed. On the other hand, it is shown by means of principal components analysis that no single index can 'explain' a large portion of the variation in Sahelian rainfall, implying that such information, which is at least potentially useful, is lost when one relies on a single index. The implications of these results are discussed in relation to assessments of the impact of drought on society in arid and semiarid regions. (Author's abstract)
W86-06052

VARIATIONS IN PRECIPITABLE WATER OVER SOME WEST AFRICAN STATIONS DURING THE SPECIAL OBSERVATION PERIOD OF WAMEX,

Ife Univ. (Nigeria). Dept. of Physics.
E. E. Balogun, and J. A. Adedokun.
Monthly Weather Review, Vol. 114, No. 4, p 772-776, April 1986. 4 fig, 3 tab, 8 ref.

Descriptors: *West Africa, *Monsoons, *Precipitation, *Weather systems, Statistics, Coasts.

The precipitable water was computed from the upper air data for 10 West African stations for the Special Observation Period of the West African Monsoon Experiment (WAMEX), 14 July to 15 August, 1979. The periodicity and the vertical distribution of precipitable water values were investigated. Comparisons of the precipitable water values showed that high positive and significant correlation existed between low-level and upper-level values for stations within the convective zone but at the coastal stations, very low but weakly significant (poor and nonsignificant at one station) correlations existed between the low-level and upper-level values. A period of 4.4 days in the precipitable water was obtained at one of the stations for which data were reliable. The relationship between this period and the period of some West African weather systems could not, however, be established with the data available. (Author's abstract)
W86-06053

INVESTIGATION OF HEAVIEST RAINFALLS OVER COASTAL ANDHRA PRADESH OF INDIA DURING OCTOBER,

Indian Inst. of Tropical Meteorology, Poona.
R. S. Reddy, B. K. Mukherjee, K. Indira, and Bh. V. R. Murty.
Monthly Weather Review, Vol. 114, No. 4, p 777-779, April 1986. 1 fig, 1 tab, 14 ref.

Descriptors: *Rainstorms, *Rainfall rate, *Andhra Pradesh, *Seasonal distribution, India, Rainfall, Kakinada, Masulipatnam, Nellore, Visakhapatnam, Flood forecasting.

An investigation of the dates of occurrence of heaviest rainfall is very important for flood forecasting. The daily rainfall data for four coastal stations in India: Kakinada, Masulipatnam, Nellore, and Visakhapatnam, for the month of October were examined over a 10-yr period, 1973-1982 and analyzed by considering the heaviest rainfalls for each station separately. The heaviest rainfall was defined as that which exceeds two or more times the mean rainfall for the month. The study shows that heaviest rainfall occurs during the period 16-23 October. This feature is repeated year after year, constituting a rainfall singularity for the region. (Author's abstract)
W86-06054

STATISTICAL ANALYSIS OF THE RELATIONSHIPS AMONG RAINFALL, OUTGOING LONGWAVE RADIATION AND THE MOISTURE BUDGET DURING JANUARY-MARCH 1979,

Hawaii Univ., Honolulu. Dept. of Meteorology.
M. L. Morrissey.
Monthly Weather Review, Vol. 114, No. 5, p 931-942, May 1986. 11 fig, 22 ref, append. NOAA grant NA 80 RAH 00002.

Descriptors: *Statistical analysis, *Rainfall, *Convection, *Outgoing longwave radiation, *Moisture budget, Pacific Ocean, Spatial distribution, Cirrus clouds.

An analysis of the statistical relationships among observed daily rainfall, outgoing longwave radiation (OLR), and the moisture budget (precipitation minus evaporation or P-E) obtained from three independent data sources during January through March 1979, indicates that on a daily basis P-E and OLR correlate significantly better with each other than they do with observed rainfall over open-ocean regions where the spatial density of rainfall observing stations is low. A spatial correlation over the Pacific Ocean indicates that P-E and OLR correlate well in most, but not all, highly

convective regions where both variables have moderate to high variances, and are uncorrelated in dry regions. Low correlations are obtained in regions of shallow convection and in areas of weak moisture convergence with cirrus at upper levels. It is demonstrated that OLR, P-E, or observed rainfall alone cannot properly define the areal extent of large-scale convective activity. A technique is developed in which P-E is used in conjunction with OLR to better establish the intensity and spatial bounds of large-scale convective activity. (Author's abstract)
W86-06055

DISCRIMINATION IN THE USE OF RADAR DATA ADJUSTED BY SPARSE GAUGE OBSERVATIONS FOR DETERMINING SURFACE RAINFALL,

British Meteorological Office, Bracknell (England).
B. R. May.
The Meteorological Magazine, Vol. 115, No. 1365, p 101-115, April 1986. 7 fig, 1 tab, 5 ref.

Descriptors: *Radar, *Interpolation, *Rainfall distribution, Rain gages, Statistics, Estimating.

Dense radar observations of a rainfall field can be adjusted by sparse gage observations to estimate the surface rainfall at an ungauged location as an alternative to direct interpolation between the gage observations. It is demonstrated that it is possible to choose which of the estimates, gage only or adjusted radar, is closest to the unknown true gage value with a success rate of correct choice of more than 50%. The purpose of choosing is to prevent the indiscriminate use of radar observations and to reduce the possibility of them being used under circumstances in which it would be non-beneficial. (Author's abstract)
W86-06056

DESIGN AND LABORATORY EVALUATION OF A SIMPLE FRACTIONATING PRECIPITATION COLLECTOR,

Aberdeen Univ. (Scotland). Dept. of Soil Science.
For primary bibliographic entry see Field 7B.
W86-06091

RECENT HEAVY PRECIPITATION IN THE VICINITY OF THE GREAT SALT LAKE: JUST HOW UNUSUAL,

National Climatic Center, Asheville, NC.
T. R. Karl, and P. J. Young.
American Meteorological Society Bulletin, Vol. 67, No. 1, p 4-9, January 1986. 3 fig, 5 tab, 10 ref. DOE Agreement No. DE-A105-850R-21501.

Descriptors: *Precipitation, *Rainfall intensity, *Great Salt Lake, *Forecasting, Mathematical studies, Time series analysis, Stochastic models, Probabilistic studies, Risk-assessment, Palmer Drought Severity Index, Wet spells, Utah.

A long time series (1963-1984) of areal-average precipitation in the vicinity of the Great Salt Lake is shown to be highly correlated with the Great Salt Lake levels, and was used to assess the unusualness of the recent episode of heavy precipitation (1981 through 1984). The Palmer Drought Severity Index (PDSI) was used to identify wet spells of weather. The analysis indicates that there were two very important wet spells in the time series, one beginning and ending in the 1860s and the most recent, which began in late 1981. The cumulative excess precipitation during each wet spell was analyzed using stochastic frequency analysis, with results suggesting that the recent heavy precipitation was not unexpected. Furthermore, if the climate of the past 100 years is representative of the climate over the next 100 years, another wet spell can be anticipated to be at least as severe, in terms of excess precipitation, as the 1981-84 wet spell. Whether lake levels can receed to sufficiently to prevent new record high levels during the next severe wet period, is uncertain, but it must be considered in risk-assessment strategies. (Jones-PTT)
W86-06099

NOTE ON WATER-VAPOR WIND TRACKING USING VAS DATA ON MCIDAS,

Cooperative Inst. for Meteorological Satellite Studies, Madison, WI.
T. R. Stewart, C. M. Hayden, and W. L, Smith.
American Meteorological Society Bulletin, Vol. 66, No. 9, p 1111-1115, September 1985. 3 fig, 3 tab, 7 ref.

Descriptors: *Water vapor, *Wind tracking, *Satellite technology, Rawinsondes, Wind waves, Mathematical analysis, Temperature.

Eleven data sets where water-vapor winds were obtained from the GOES-5 6.7-micrometer measurement over the United States are compared with rawinsondes. Over 2000 point comparisons were made for: a) an arbitrary height assignment of 400 micrometer brightness (mb); and b) a height assignment determined by matching the brightness temperature to the temperature structure represented in the LFM (Limited Area Fine Mesh) analysis. Analysis indicated that the water vapor winds provide a uniform horizontal coverage of midlevel flow with high accuracy (8 mps vector RMS). Furthermore the radiometric height assignment significantly improves the accuracy. (Jones-PTT)
W86-06100

EVALUATION OF THE SLOSH STORM-SURGE MODEL,

National Hurricane Center, Coral Gables, FL.
B. R. Jarvinen, and M. B. Lawrence.
American Meteorological Society Bulletin , Vol. 66, No. 11, p 1408-1411, November 1985. 4 fig, 11 ref.

Descriptors: *SLOSH, *Model studies, *Storm surges, Storms, Surges, Hurricanes, Evacuation planning, Mathematical model, Flood forecasting, Historic floods, Error analysis.

The National Weather Service SLOSH (sea, lake, and overland surges from hurricanes) storm-surge model is described and the model's role in the issuance of hurricane warnings and the preparation of regional evacuation plans is discussed. An error distribution for the model is estimated by comparing observed surge heights with model calculations for several historical hurricanes. Results from a National Weather Service numerical storm-surge model are becoming available along a number of U. S. coastal basins. These results provide an estimate of the flood potential caused by hurricane-generated storm-surge water, along both the open coast and inland. This information is then used by local and regional planners for evacuation planning, and by the National Hurricane Center for guidance in issuing hurricane warnings. Error analysis indicates that under ideal conditions-- when the hurricane track and intensity are known-- model surge-height errors are less than 0.6 m, 79% of the time and exceed 1.8 m only 1% of the time. (Jones-PTT)
W86-06101

APPLICATION OF MODEL OUTPUT STATISTICS TO PRECIPITATION PREDICTION IN AUSTRALIA,

Bureau of Meteorology, Melbourne (Australia).
R. G. Tapp, F. Woodcock, and G. A. Mills.
Monthly Weather Review, Vol. 114, No. 1, p 50-61, January 1986. 8 fig, 6 tab, 40 ref.

Descriptors: *Statistical modeling, Weather forecasting, *Precipitation.

The Model Output Statistics (MOS) technique was used to produce forecasts of both the probability of precipitation and the rain amount for seven major Australian cities in subtropical and middle latitudes. Single station equations were generated using data from the current objective analysis, together with some surface observations for the same time, and a 24 h prognosis based on that analysis, to predict the rainfall in the 24 h beyond the prognosis validity time. In order to increase the usefulness and acceptability of the MOS predictions, transformations were applied that reduced the biases of the final forecasts throughout the forecast ranges. The skill with which large rainfall totals were predicted was particularly enhanced in this manner: the MOS forecasts showed much greater skill in the prediction of large totals than was achieved by either the operational or persistence forecasts, while predicting small totals with comparable proficiency. The MOS probability forecasts were better able to predict rainfall occurrence than were the quantitative MOS forecasts, and additionally were superior in this regard to both subjective forecasts produced operationally and predictions based on persistence. The overall skill of the quantitative precipitation forecasts was further enhanced by using the probability estimates to provide a categorical prediction of rain occurrence such that a rain amount was only forecast if the predicted probability of precipitation exceeded 50%. Routine issuance of the MOS guideance to the operational forecasters commenced in January 1984. (Author's abstract)
W86-06121

STATISTICALLY DERIVED PREDICTION PROCEDURE FOR TROPICAL STORM FORMATION,

Naval Environmental Prediction Research Facility, Monterey, CA.
T. J. Perrone, and P. R. Lowe.
Monthly Weather Review, Vol. 114, No. 1, p 165-177, January 1986. 3 fig, 11 tab, 28 ref.

Descriptors: *Statistical models, *Weather forecasting, *Tropical cyclones, Satellite technology.

A statistical forecasting experiment was performed to test the capability of predictors derived from observational data (analysis) fields at 950, 700, 500, and 200 mb to forecast tropical storm formation (genesis). National Oceanographic and Atmospheric Administration tropical mosiac visible satellite images and the Joint (United States Navy and Air Force) Typhoon Warning Center's Post-Season Best Track analyses of tropical storms were used to select a representative collection of tropical storm clusters, some of which became tropical storms (GO cases), others of which did not (NO GO cases). Navy Fleet Numerical Oceanography Central archived analysis fields of surface pressure, winds, sea surface temperature, and moisture were accessed at locations and times corresponding to cloud cluster positions 24, 48 and 72 hours prior to tropical storm formation/nonformation, and candidate predictors were formed from these analysis data. The number of predictor candidates was increased by also calculating a predictor candidate's Laplacian, and the magnitude of its gradient. A special local-maximum enhancement technique was also applied to some of the candidate predictors. Stepwise discriminant analysis was applied to these candidate predictors to select subsets with greatest predictive capability for forecasting tropical storm formation at projections of 24, 48 and 72 hours. The resulting statistical forecast algorithms were evaluated on independent data, against climatology, and against a basic technique derived solely from latitude and longitude. The results show that the forecast technique possesses considerable utility in predicting tropical storm formation with good pre-figurance, post-agreement, threat, and Brier scores. (Author's abstract)
W86-06122

SOME EFFECTS OF SURFACE HEATING AND TOPOGRAPHY ON THE REGIONAL SEVERE STORM ENVIRONMENT. PART I: THREE-DIMENSIONAL SIMULATIONS,

National Center for Atmospheric Research, Boulder, CO.
S. G. Benjamin, and T. N. Carlson.
Monthly Weather Review, Vol. 114, No. 2, p 307-329, February 1986. 27 fig, 3 tab, 45 ref. U.S. Air Force Grants No. AFOSR-79-0125 and AFOSR-83-0064.

Descriptors: *Model simulations, *Storms, *Topography, Thunderstorms, Solar radiation, Advection, Weather.

Model experiments have isolated several effects of surface heating and topography which may act in concert to focus the potential for severe thunder-

storms in certain areas downstream of dry elevated terrain. Comparisons of simulations with and without surface fluxes of heat and moisture confirm that differential surface heating, topography, and differential advection may combine to produce a stabilizing effect. In certain synoptic situations, air strongly heated over the arid Mexican plateau rides over moist potentially cooler air downstream, thereby forming a strong restraining inversion or 'lid' over Texas. This elevated mixed layer inversion prevents the occurrence of thunderstorms over a large area; instead, storms are focused in the region where a southeasterly low-level flow underruns the northern and western boundary of the inversion. Model trajectories also support the hypothesis that this lateral boundary of the lid, a baroclinic zone approximately between 800 and 500 mb, is formed by confluence between the Mexican airstream and a subsided polar airstream which has traversed the upper-level trough approaching from the western United States. (See also W86-06131) (Author's abstract)
W86-06130

SOME EFFECTS OF SURFACE HEATING AND TOPOGRAPHY ON THE REGIONAL SEVERE STORM ENVIRONMENT. PART II: TWO-DIMENSIONAL IDEALIZED EXPERIMENTS,

National Center for Atmospheric Research, Boulder, CO.
S. G. Benjamin.
Monthly Weather Review, Vol. 114, No. 2, p 330-343, February 1986. 15 fig, 2 tab, 35 ref. U.S. Air Force Grants No. AFOSR-79-0125 and AFOSR-83-0064.

Descriptors: *Storms, *Thunderstorms, Topography, Solar radiation, Advection, Weather, Air-earth Interfaces.

Two-dimensional numerical experiments were conducted to examine the effects of differential surface heating on flow over a dry, 2000 km-wide plateau. Two effects found in three dimensional simulations to be significant in the regional severe storm environment also occur in these two dimensional experiments. These effects are a diurnal variation in the intensity of the lee trough and the development of a low-level inversion downstream as the mixed layer, which developed over the hot plateau, is advected over potentially cooler air. When the plateau is strongly heated and surrounded by lowlands with no surface heating, the leeside pressure trough intensifies by an extra 1-3 mb. Subsequently, the low-level flow ahead of the lee trough also increases by several meters per second when surface heating is allowed. The diurnal modulation of this feature suggests that the low-level moist flow toward regions of potential convection will tend to be strongest in the late afternoon and early evening. It is shown that this effect is primarily due to the superposition of a plateau heat low upon the mountain wave circulation. To a lesser extent, differential vertical mixing of momentum between the deep mixed layer and surrounding regions also tends to enhance the lee trough. This differential mixing momentum mechanism is active in the presence of an isolated, deep mixed layer and moderately strong lower tropospheric flow even if there is no elevated terrain. The development of the elevated mixed layer inversion appears to depend more strongly on a horizontal gradient of soil moisture and surface heating than it does upon a gradient of terrain elevation. However, while such an inversion may be produced by differential advection and differential heating in the absence of terrain, it will be stronger and develop more rapidly in a shearing environment if the strongly heated region is also elevated. (See also W86-06130) (Author's abstract)
W86-06131

NUMERICAL SIMULATION OF CLOUDS, RAIN, AND AIRFLOW OVER THE VOSGES AND BLACK FOREST MOUNTAINS: A MESO-BETA MODEL WITH PARAMETERIZED MICROPHYSICS,

National Oceanic and Atmospheric Administration, Boulder, CO. Air Resources Lab.
E. C. Nickerson, E. Richard, R. Rosset, and D. R. Smith.
Monthly Weather Review, Vol. 114, No. 2, p 398-414, February 1986. 17 fig, 1 tab, 39 ref, 2 append.

Descriptors: *Clouds, *Rain, Simulation models, Numerical analysis, Weather forecasting.

A three-dimensional meso-beta model with parameterized microphysics is presented. The model is capable of simulating orographically forced clouds, rain, and airflow. A two-dimensional version has shown that the vertical resolution in the 15-layer model is adequate to damp and prevent the unwanted reflection of vertically propagating waves in the absorbing layer at the top of the model domain. Tests using the two-dimensional version confirm the ability of the model to replicate the linear and nonlinear mountain wave simulations of previous authors. The model is applied to the Rhine Valley and the surrounding mountainous areas, the Vosges in France and the Black Forest in Germany. Model-predicted rainfall over the mountainous areas is in good agreement with observations in both magnitude and location; however, an absence of model-predicted cloud cover over the Rhine Valley suggests the need for an improved mesoscale initialization procedure. (Author's abstract)
W86-06132

PHYSICS OF MONSOON RAIN PROCESSES,

Indian Inst. of Tropical Meteorology, Poona.
P. C. S. Devara, and Bh. V. R. Murty.
Mausam, Vol. 35, No. 4, p 435-452, October 1984. 16 fig, 2 tab, 187 ref.

Descriptors: *Cloud physics, *Rainfall, *Monsoons, Clouds.

The principles and related phenomena involved in the two basic rain processes, namely, the warm rain (all liquid process) and the cold rain (three phase process), which govern formation of rain in clouds are reviewed. The extent of operation of these processes in the raining clouds during the summer monsoon has been pointed out on the basis of observations made over certain regions in India. The results obtained so far suggest that the monsoon rain occurs in India predominantly due to cold process, partly due to a combination of cold and warm processes, and negligibly due to warm process. The warm rain process occurs in convective cloud fields when the rainfall is showery and scattered in nature. The combined rain process occurs in similar situations but the intensity and duration of showers is larger. The cold rain process occurs in situations of widespread continuous type rainfields. (McFarlane-PTT)
W86-06133

MESO-SCALE STUDY OF CROP DROUGHT CLIMATOLOGY OVER MAHARASHTRA,

Meteorological Office, Poona (India).
S. Venkataraman, and N. N. Khambete.
Mausam, Vol. 35, No. 4, p 475-478, October 1984. 2 fig, 6 ref.

Descriptors: *Weather forecasting, *Drought relief, *Climatology, *Drought, Dry farming, India.

A climatological assessment of the likely frequencies of occurrence of various classes of crop droughts is useful in assigning priorities for provision of surface irrigation facilities and planning long term measures of drought mitigation for drought prone area development. Comparative assessments of spatial variations in drought intensity in a year can provide an operational basis for organizing drought relief measures on a rational basis. The areal spread of historical droughts from 1901-1970 in 16 dry farming districts of Maharashtra is summarized and mapped. (McFarlane-PTT)
W86-06134

PRESENCE OF UPPER AIR DIVERGENCE IN RELATION TO PRE-MONSOON AND MONSOON WEATHER SYSTEMS OF THE MONEX PERIOD 1979,

Meteorological Office, Poona (India).
R. Singh.
Mausam, Vol. 35, No. 4, p 507-514, October 1984. 5 fig, 2 tab, 15 ref.

Descriptors: *Monsoon, *Weather forecasting, Atmosphere, Satellite technology, Remote sensing.

A case of formation of a cyclonic storm in the Bay of Bengal and some cases of intensification of equatorial trough during the pre-monsoon period were studied with the help of GOES-1 satellite wind flow data. It could be inferred that divergence in these cases was mostly generated and the development took place without the movement of any pre-existing divergent system aloft. Onset of the southwest monsoon along the west coast, together with formation of a cyclonic storm in the Arabian Sea and three other cases of formation of depression in the Bay of Bengal were examined in light of the wind flow data. The development of these systems took place in the presence of upper air divergence systems. The interaction of the low level system with the upper circulation depends on the intensity of the developing system as to whether it is a severe tropical cyclone, a monsoon depression, or a weak mid-tropospheric cyclone vortex. In the pre-monsoon season such interactions seem to cause distinct outflow centers and modify the upper air circulation at meso and synoptic scale of motions. In monsoon season the system outflow is carried off by the pre-existing strong easterlies aloft and the outflow center is obliterated. (McFarlane-PTT)
W86-06135

APRIL EVAPORATION IN RELATION TO SUBSEQUENT MONSOON RAINFALL IN INDIA,

Meteorological Office, Poona (India).
S. J. Maske, and R. P. Samui.
Mausam, Vol. 35, No. 4, p 525-530, October 1984. 12 fig, 6 ref.

Descriptors: *Rainfall, *Monsoons, *Evaporation, *Climatology, India, Drought, Weather forecasting.

Monthly mean evaporation charts for the months March to May are examined year by year for the period 1965 to 1975 in relation to behavior of the subsequent monsoon rainfall in India. April charts, in general, show one primary and one secondary region of high evaporation in the years where the subsequent monsoon rainfall is normal over the country. The primary region of high evaporation belt extends from Gujarat to Andhra Pradesh through Maharashtra and adjoining Karnataka. It is found for both normal and deficient years. In most of the deficient years (1965, 1968 and 1972) the pattern changes substantially; the secondary region which extends from Rajasthan to Madhya Pradesh disappears from its normal position. No such change in the evaporation pattern is found in the months of March and May. Though the secondary region disappeared in April 1970, which was a good monsoon year, there was no shrinkage in total area coverage of high evaporation belt. It appeared that the secondary region shifted towards the west and formed a bigger region of high evaporation belt in combination with the primary region. (Author's abstract)
W86-06136

RETURN PERIOD ANALYSIS OF EXTREME RAINFALL EVENTS,

Meteorological Office, New Delhi (India).
S. C. Goyal, and S. N. Kathuria.
Mausam, Vol. 35, No. 4, p. 531-536, October 1984. 2 fig, 4 tab, 7 ref.

Descriptors: *Rainfall, *Frequency analysis, India, Weather forecasting.

The return periods of extreme rainfall events for 15 selected stations in the Krishna River basin were analyzed. The annual one-day rainfall data for the period 1901-60 was used. The rainfall estimates were computed for different return periods using two different distributions - Gumbel's distribution and the Fisher and Tipett type II distribution. Return periods corresponding to the highest re-

corded rainfall were interpolated for both distributions. The Gumbel's distribution indicated very high return periods of extreme events, while the the Fisher and Tipett type II distribution provided lower estimates of recurrence interval. As rainfall events are randomly distributed in nature, the return periods of outliers should also be determined with reasonable accuracy. For return periods of more than 25 years, the Gumbel's technique does not estimate some highest rainfall events within acceptable degree of accuracy for certain conditions of rainfall occurrence. (McFarlane-PTT)
W86-06137

RUN ANALYSIS OF RAINFALL DATA AFFECTED BY URBANIZATION,

Hydrocon, Inc., Clarkston, GA.
S. G. Rao, and A. R. Rao.
Nordic Hydrology, Vol. 17, No. 1, p 47-64, 1986. 1 fig, 7 tab, 19 ref. OWRT Grant No. OWRR-B-025-IND and Purdue Research Foundation Grant XR-6606.

Descriptors: *Run analysis, *Rainfall, *Urbanization, Rainfall intensity, Rainfall distribution, Statistical analysis, Markov Process, La Porte, Indiana, Monthly distribution, Annual distribution.

Urbanization generally increases the amount of rainfall in urban areas and/or downwind areas of urban centers. This paper investigates whether urbanization significantly changes the run properties of rainfall. Three run properties, the run-length, run-sum and run-intensities of positive (surplus) and negative (deficit) runs, of the annual and monthly rainfall were evaluated by using the theory of runs. Annual rainfall was assumed to be normally or gamma distributed, and the monthly rainfall assumed to follow a two-state Markov chain with stationary, transition probabilities. The methodology was applied to annual and monthly rainfall data at La Porte and three surrounding stations in Indiana. The results indicated that these assumptions were adequate to characterize the annual and monthly rainfall. The following conclusions were drawn: 1) the run properties such as run-lengths, run-sums or run-intensity are not significantly affected by urbanization; 2) run intensity is a better indicator of changes in rainfall than run-lengths or run-sums; and 3) the run properties of both annual and monthly rainfall data at La Porte are not significantly different from those at the surrounding stations, even though La Porte has received increased rainfall in comparison with its environs as a result of urbanization. The run properties of La Porte annual data in the pre- and post-urbanized periods appear to be different. However no significant differences were observed in the run properties of monthly data at La Porte in these two periods. (Lantz-PTT)
W86-06166

2C. Snow, Ice, and Frost

MESOSCALE FREQUENCIES AND SEASONAL SNOWFALLS FOR DIFFERENT TYPES OF LAKE MICHIGAN SNOW STORMS,

Chicago Univ., IL. Dept. of Geophysical Sciences.
For primary bibliographic entry see Field 2B.
W86-05417

RELATIONSHIPS FOR DERIVING THUNDERSTORM ANVIL ICE MASS FOR CCOPE STORM WATER BUDGET ESTIMATES,

National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 2B.
W86-05464

THERMOEROSION OF FROZEN SEDIMENT UNDER WAVE ACTION,

Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W86-05504

MEASUREMENT OF AREAL WATER EQUIVALENT OF SNOW BY NATURAL GAMMA RADIATION - EXPERIENCES FROM NORTHERN SWEDEN,

Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
S. Bergstrom, and M. Brandt.
Hydrological Sciences - Journal - des Sciences Hydrologiques HSJODN, Vol. 30, No. 4, p 465-477, December 1985. 9 fig, 2 tab, 8 ref.

Descriptors: *Gamma-ray spectrometry, *Remote sensing, *Snow surveys, *Water equivalent of snow, Airborne gamma-ray spectrometry, Gamma radiation, X-rays.

Natural radioactive elements in the ground are the sources of gamma radiation from the surface. The attenuation of this radiation due to the water equivalent of the snowpack is the foundation for the use of gamma-ray spectrometry for snow mapping and hydrological forcasting. Normally the two-flight method is used. The Kultsjon Basin in northern Sweden has been the subject of detailed studies of the potential of airborne gamma-ray spectrometry for snow mapping and hydrological forecasting. Results from five melt seasons are presented, and problems and uncertainties are discussed. A verification against ground truth based on snow courses, runoff measurements and hydrological models is given. Finally it is shown how the data can be used for updating and improving more conventional forecasting models. The experiences from the experiment can be summarized as follows: 1) the airborne gamma-technique cannot be used for small-scale snow estimation; 2) The technique has an obvious potential for the estimation of basin snow storage in basins larger than 100 sq km; side effects from bare rocks in a rugged terrain and wet areas can seriously affect the measurements. These parts of the flight lines have to be excluded; 3) verification is a difficult task, but is facilitated by the use of runoff data and a conceptual runoff model; 4) the technique is particularly sensitive to variations in background radiation caused mainly by radon and cosmic radiation; 5) the stability of the snow estimates is good, if winter or summer flights are repeated; 6) even a relatively dense network of flight lines requires an empirical correction of the gamma-registrations, to arrive at a basin snow storage; 7) the costs are high compared to conventional hydrological forecasting techniques; and 8) the project has not been able to answer the important question of the upper limit of snowpack that can be observed by airborne gamma-ray measurements. (Khumbatta-PTT)
W86-05543

HYDROLOGICAL ASPECTS OF ALPINE AND HIGH-MOUNTAIN AREAS.

Institute of Hydrology, Wallingford (England).
Available from IAHS, 2000 Florida Ave., NW., Washington, DC. 20009. IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. Edited by J. W. Glenn. 350 p.

Descriptors: *Hydrology, *Glaciers, *Alpine regions, *Snow, Ice, Hydrologic aspects, Watersheds, Erosion, Water management, Runoff, Mountains, Rivers.

Many aspects of the hydrology of mountainous regions are discussed, including regional and general aspects of alpine hydrology, characteristics of water storage in snow, characteristics of water storage and drainage in glaciers, characteristics of water storage and release by snow, modeling runoff processes in alpine areas, runoff processes in mountain basins in alpine areas, and erosion, sediment transport, and deposition in mountain areas. (See also W86-05611 thru W86-05644) (Halterman-PTT)
W86-05610

OROGRAPHIC VARIATION OF PRECIPITATION IN A HIGH-RISE HIMALAYAN BASIN,

Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W86-05611

MAPS OF STREAMFLOW RESOURCES OF SOME HIGH-MOUNTAIN AREAS IN ASIA AND NORTH AMERICA,

Akademiya Nauk SSSR, Moscow. Inst. Geografii.
For primary bibliographic entry see Field 2E.
W86-05612

CHARACTERISTICS OF PRECIPITATION DURING THE MONSOON SEASON IN HIGH-MOUNTAIN AREAS OF THE NEPAL HIMALAYA,

Nagoya Univ. (Japan). Water Research Inst.
For primary bibliographic entry see Field 2B.
W86-05613

INVESTIGATIONS OF THE HYDROLOGICAL CONDITIONS OF ALPINE REGIONS BY GLACIOLOGICAL METHODS,

Akademiya Nauk SSSR, Moscow. Inst. Geografii.
V. M. Kotlyakov, and A. N. Krenke.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 31-42, 4 fig, 2 tab, 20 ref.

Descriptors: *Hydrologic aspects, *Hydrologic budget, *Watersheds, *Alpine regions, Mountains, Precipitation, Snow, Rainfall, Discharge hydrographs, Himalaya, Glaciers, Caucasus, Pamirs.

Plotting the fields of precipitation and glacier runoff in mountains from data on ablation at the height of the equilibrium line permit the reconstruction of the meso-scale peculiarities of moisture transport in the mountains. Glaciers are indices of maxima in humidification fields are shown. Potentialities of the thermal development method for plotting the snow-storage fields in mountains are analyzed. The analysis of the results of tests on the Caucasus and the Pamirs, two large mountain ranges, have introduced new concepts of the nature of glacio-nival zones and the peculiarities of humidification in the alpine region. (See also W86-05610) (Halterman-PTT)
W86-05614

HYDROLOGICAL ASPECTS OF THE GLACIER REGIME IN THE NORTH TIEN SHAN IN THE ANOMALOUSLY ARID PERIOD OF 1974-1978,

Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Sektor Fizicheskoi Geografii.
K. G. Makarevich.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 43-50, 4 tab, 6 ref.

Descriptors: *Glaciers, *Hydrologic aspects, *Watersheds, Alpine regions, Mountains, Snow, Ice, Glaciohydrology, Hydrology.

The anomalously arid period of 1974-1978 in the Tien Shan resulted in a reduction of the winter accumulation as well as of the net balance, and a considerable increase in the ablation of old ice in the height of the equilibrium line. The net balance remained negative for the entire five-year period and amounted to 145 g/sq cm. The rise of the equilibrium line caused changes in the zones of ice formation, an extension of the accumulation area by 30-70%, and a reduction of the area of the cold firn zone over 4000 m above sea level. The rate of runoff from the accumulation area increased. Glacial discharge made up 32% of the annual runoff volume in the rivers flowing from the areas with glacierization increased by 40%. The glacial water supply also sharply increased. (See also W86-05610) (Author's abstract)
W86-05615

HYDROLOGICAL RELATIONSHIPS IN A GLACIERIZED MOUNTAIN BASIN,

Inland Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 2E.
W86-05616

FLOW PATTERN OF MELTWATER IN MOUNTAIN SNOW COVER,

Nagoya Univ. (Japan). Water Research Inst.
K. Higuchi, and Y. Tanaka.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 63-69, 7 fig, 6 ref.

Descriptors: *Runoff, *Snowmelt, *Hydrology, Watersheds, Alpine regions, Mountains, Snow, Hydrologic aspects.

Field observations were carried out to study the morphological regularity of the dendritic pattern on a snow surface, and the relation between the pattern and flow of meltwater in snow cover. The main results are as follows: (a) The direction of surface depressions was nearly parallel to the direction of the maximum inclination of snow slope; (b) The distance between neighoring depressions was about 1.0 to 1.2 m, with a frequency distribution whose probability density function is f(X) = (alpha/beta) (X - gamma) (beta - 1) to the (-(X - gamma) beta/alpha) where the values of the parameters are alpha = 1.37, beta = 1.66 and gamma = 0.30 where distance is shown by X; and (c) The snow layer under the surface depression has a higher content of meltwater and also dust particles, and coarser snow grains as compared with snow in other parts. Therefore, it can be said that the dendritic pattern at the snow surface corresponds to flow channels of meltwater in the snow cover. (See also W86-05610) (Author's abstract)
W86-05617

WATER STORAGE AND DRAINAGE WITHIN THE FIRN OF A TEMPERATE GLACIER (VERNAGTFERNER, OETZTAL ALPS, AUSTRIA),

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie.
H. Oerter, and H. Moser.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 71-81, 5 fig, 3 tab, 10 ref, 1 append.

Descriptors: *Glaciers, *Snowmelt, *Hydrological aspects, Hydrological budget, Alpine regions, Hydrology, Mountains, Snow, Ice, Hydraulic models, Tracers, Drainage systems.

Various aspects of the flow of meltwater in water-saturated firn of a temperate glacier are discussed. The storage of meltwater in the firn, treated as a porous medium, was studied in boreholes by measuring the water level. It was shown that at a depth of 20 m below the glacier surface, a water-bearing layer exists every year which shows strong annual variations. The assumption is made that the water bearing firn layer within the glacier extends over the whole firn area during the ablation period, that water flow takes place there, and that the water body must be interrupted at distances of about 100 m by drainage systems. Tracer studies conducted in other glacier systems were in close agreement with the predictions presented here. (See also W86-05610) (Halterman-PTT)
W86-05618

SNOW ACCUMULATION DERIVED FROM MODIFIED DEPLETION CURVES OF SNOW COVERAGE,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
A. Rango, and J. Martinec.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 83-90, 7 fig, 1 tab, 5 ref.

Descriptors: *Snowmelt, *Snow, *Snow accumulation, Snow management, Satellite technology, Remote sensing, Alpine regions, Mountains, Runoff, Discharge hydrographs.

Comparison of satellite images of mountain basins demonstrates that large variations in the snow accumulation in different years cannot be detected solely from data on the snow-covered area. To provide a means for forecasting runoff using a snowmelt-runoff model, the depletion curves that normally relate the areal extent of snow cover to elapsed time must be modified to relate snow coverage to the accumulated degree-days. With an estimate of the water-equivalent of the snow in the basin at the beginning of the snowmelt, an appropriate modified depletion curve can be chosen for use in runoff forecasts using the model. Actual satellite snow-cover observations made during the snowmelt period can be used for updating the depletion curve and the forecast. The course followed by the modified depletion curve during the first month of the snowmelt season also permits the estimation of the snow accumulation in the basin with reference to accumulation experienced in previous years. (See also W86-05610) (Author's abstract)
W86-05619

VARIATIONS OF THE HYDROLOGICAL PROPERTIES OF ALPINE SNOW-COVER STORES,

Technische Univ. Braunschweig (Germany, F.R.). Lehrstuhl fuer Physische Geographie und Landschaftsokologie.
R. G. Rau, and A. Herrmann.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 91-100, 5 fig, 1 tab, 16 ref.

Descriptors: *Hydrological aspects, *Snowmelt, *Snow accumulation, Watersheds, Alpine regions, Mountains, Precipitation, Snow, Runoff, Oetztal Alps, Austria.

A conceptual model, based on experimental snow profile data collected in the Oetztal Alps, was developed to describe the evolution in time of a temporary alpine snow-cover. In this model, a period of stratification and a period of homogenization are separated by a critical interval. The critical period, defined by the breakdown of the cold content of the snow cover, lasts about two weeks. This period induces a characteristic transformation of the properties of the snow-cover store which initiates meltwater runoff in a transition interval of about two months. This model gives reasonable criteria for locating the starting points of snowmelt and basin meltwater runoff simulation models. (See also W86-05610) (Halterman-PTT)
W86-05620

GLACIER DISCHARGE MODEL BASED ON RESULTS FROM FIELD STUDIES OF ENERGY BALANCE, WATER STORAGE AND FLOW,

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Strahlenschutz.
D. Baker, H. Escher-Vetter, H. Moser, H. Oerter, and O. Reinwarth.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 103-112, 4 fig, 11 ref.

Descriptors: *Glaciohydrology, *Hydrological aspects, *Snowmelt, *Water storage, *Model studies, Glaciers, Snow, Runoff, Discharge hydrographs, Glacial discharge, Energy balance model.

A discharge model the runoff of a glacier using the meltwater production on its surface as input data. Based on runoff and meteorological measurements, the meltwater production for any point of the glacier surface is calculated with the aid of an energy balance model. This serves as input for the discharge model, which consists of three parallel linear reservoirs corresponding to runoff from three different areas of the glacier, plus a fourth ground component. The hourly mean values of the model output were in close agreement with recorded runoff for model verification during ablation. (See also W86-05610) (Halterman-PTT)
W86-05621

WATER STORAGE IN AN ALPINE GLACIER,

Victoria Univ. of Manchester (England). Dept. of Geography.
D. N. Collins.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 113-122, 3 fig, 1 tab, 12 ref.

Descriptors: *Water storage, *Discharge hydrographs, *Glaciers, *Alpine regions, Hydrologic aspects, Reservoirs, Snow, Snowmelt, Mountains, Gornergletscher, Switzerland, Mathematical analysis.

Periods of recession flow resulting from greatly reduced ablation following summer snowfall events were examined in discharge hydrographs of the Gornera, continuously recorded close to the portal of Gornergletscher, Switzerland, during the ablation seasons of 1970-1979. Where possible, recession curves were separated into two or three sections. Recession constants were calculated, permitting estimation of the volumes of water stored in a fast reservoir (runoff of water derived from ice-melt through the moulin-conduit system) and a slower linear reservoir (water draining more slowly from the firn aquifer). Summer storage in the linear reservoir was between 0.32 - 2.38 million cu m, and total storage in the glacier (fast and linear reservoirs) ranged from 0.34 - 2.78 million cu m at the commencement of depletion events. During recession, between 55.8% and 94.9% of the initial storage contributed to portal runoff. Temporal variations of the volume of liquid water retained reflect sequential hydrological periods experiencing contrasting meteorological conditions which condition the capacity of the conduit network, rather than following a seasonal trend. (See also W86-05610) (Author's abstract)
W86-05622

IMPORTANCE OF THE STRUCTURE OF THE GLACIER INTERNAL AND EXTERNAL RUNOFF SYSTEM OF CHANNELS AND STREAMS TO GLACIER ACTIVITY,

Akademiya Nauk SSSR, Moscow. Inst. Geografii.
A. B. Kazanskiy.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 123-130, 2 fig, 2 ref.

Descriptors: *Glaciers, *Runoff, *Snowmelt, Hydrologic aspects, Hydrology, Watersheds, Alpine, Mountains, Snow, Discharge hydrographs, Heat transfer, Caucasus Mountains, Pamir Mountains, USSR.

The existence of a natural mechanism of glacier self-regulation occurring as a result of the redistribution of the heat, dissipated on melting by meltwater flow, has been predicted on the basis of the theory presented. It is shown that meltwater flowing in a glacier intercepts part of the heat coming from the atmosphere, thus diminishing the total amount of heat that might be spent on melting. This heat transported downstream by meltwater is added, in another part of glacier, to heat coming from above, and increases the melting there. This heat redistribution is regulated by the structure of the network of streams and channels in a glacier, ie., their depth, and tortuosity. Despite the relatively small impact of this effect, it may appreciably influence the morphology of the glacier due to its regular action throughout the melting period. Measurements made on Caucasian glaciers and in the summer of 1981 in the Pamirs have confirmed the existence of this mechanism. In addition to supporting the scheme of natural self-regulation, the phenomenon gives us an approach to estimating the possible after-effects of artifical changes in the system of meltwater runoff in glaciers. (See also W86-05610) (Author's abstract)
W86-05623

MODELING RUNOFF FROM A GLACIERIZED BASIN,

Norges Vassdrags- og Elektrisitetsvesen, Oslo.
D. Lundquist.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 131-136, 4 fig, 4 ref.

Descriptors: *Glaciers, *Runoff, *Model studies, *Snowmelt, Snow, Ice, Hydrology, Hydrologic budget, Hydrologic aspects, Alpine regions, Mountains, Precipitation.

A meltwater model for snow and ice is described and simulations of diurnal and day-to-day variations in runoff from a glaciated basin are presented. The model calculates meltwater production from observed values of air temperature at two different altitudes. Internal glacier-drainage is also modeled. Radiation, the main factor influencing snowmelt and ice-melt, is discussed, and the mathematical considerations of radiation, with regard to the model, are presented. The planned future uses of the model are described. They include modeling extreme daily temperature variation and largest observed floods. (See also W86-05610) (Halterman-PTT)
W86-05624

SIMPLIFIED MODEL FOR ESTIMATING GLACIER ABLATION UNDER A DEBRIS LAYER,

M. Nakawo, and S. Takahashi.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 137-145, 3 fig, 18 ref.

Descriptors: *Ablation, *Glaciers, *Model studies, Snow, Ice, Alpine regions, Hydrology, Mountains, Model studies, Debris layer.

In order to predict the ablation of glacier ice under a debris layer, a simple model is proposed. Required data for the prediction are global radiation, air temperature, the degree-day factor around the area to be investigated, albedo of debris-free ice, and critical thermal resistance of the debris cover. It is shown that this latter variable can be estimated from the four former variables, which are comparatively easy to measure or estimate. Regarding the physical properties of the debris layer per se, its albedo and thermal resistance need to be given. The predictions of this model compare favorably with field observations. (See also W86-05610) (Author's abstract)
W86-05625

OPERATIONAL SNOW MAPPING BY SATELLITES,

Norges Vassdrags- og Elektrisitetsvesen, Oslo.
T. Andersen.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 149-154, 3 fig, 5 ref.

Descriptors: *Satellite technology, *Mapping, *Snow, *Snow accumulation, *Snow cover, Snow management, Snow surveys, Snow melt, Hydrology, Hydrologic aspects, Norway.

A method of deriving snow information from weather and ocean satellites is described. The method is developed in order to improve operational forecasting of inflow to reservoirs for hydroelectric power production in the snow-melting period. Due to the topography typical for Norwegian mountain basins, the snowline concept is not useful. A better description of the snow distribution is achieved by using the satellite data to determine the area of snow cover within each picture element by using reference areas with known snow coverage. The method is well suited for drainage basins larger than 200 sq km, located above the tree limit. Advanced equipment is required for handling the data and extracting the information. Cloud cover is the limiting factor for the use of this method. If the method is used in an operational routine, the snow maps should be ready one or two days after the data are obtained. Such snow maps can improve the discharge forecasts and thus the power production, especially if at least limited data on the water equivalent of snow are available. (See also W86-05610) (Author's abstract)
W86-05626

APPLICATION OF COSMIC RAYS TO THE SOLUTION OF SOME HYDROLOGICAL PROBLEMS,

Institut Prikladnoi Geofiziki, Moscow (USSR).
S. I. Avdyushin, E. V. Kolomeyets, I. M. Nazarov, A. N. Pegoyev, and Sh. D. Fridman.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 155-160, 2 fig, 3 ref.

Descriptors: *Cosmic rays, *Ice, *Snow, Water management, Water measurement, Water resources development, Water storage, Hydrologic aspects, Hydrologic budget, Runoff, Runoff hydrographs, Neutron absorption, Radiation, Malaya Almantinka River, USSR.

The physical priciples of a method for measuring the water content of snow by cosmic-ray attentuation are outlined. The accuracy and efficienty of the method are evaluated. The best results of water content measurement have been obtained from the neutron cosmic-ray component. The characteristics of an experimental system for remote automatic measurement of water content of snow by cosmic-ray attentuation are discussed. The results of water content measurement at several locations in the mountains of Zailiyskiy Alatau are presented. These are in good agreement with the results of obtained by other methods. The data obtained are shown to be suitable for forecasting the runoff of the mountain river Malaya Almatinka. The suitability of the method for recording mudflows and determining their structure is pointed out. (See also W86-05610) (Author's abstract)
W86-05627

ASSESSING SNOW STORAGE AND MELT IN A NEW ZEALAND MOUNTAIN ENVIRONMENT,

Otago Univ., Dunedin (New Zealand). Dept. of Geography.
B. B. Fitzharris, and C. S. B. Grimmond.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 161-168, 3 fig, 1 tab, 23 ref.

Descriptors: *Ice, *Snow, *Water management, *Water storage, Water measurement, Runoff, Runoff hydrographs, Snow accumulation, Snow surveys, Snowmelt, Fraser Basin, New Zealand.

Various aspects of a water balance approach to calculating the size of seasonal snow storage, for the Fraser basin in the South Island of New Zealand, are presented. The energy sources, for melt in this grassland, wind-swept mountain basin of 120 sq km, are assessed for a major flood. Runoff is maximum in October, when it averages 2.8 times the mean annual flow. Mean snow storage over 10 years was 176 mm, or one third of the annual flow. During the flood, a snow pillow recorded 97 mm of melt in 43 hours. It is calculated that over half the energy at the melting snow surface came from convection of sensible and latent heat. (See also W86-05610) (Halterman-PTT)
W86-05628

SNOWMELT AND GROUNDWATER STORAGE IN AN ALPINE BASIN,

Eidgenoessisches Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
For primary bibliographic entry see Field 2F.
W86-05629

WATER RESOURCES INVESTIGATIONS IN PAKISTAN WITH THE HELP OF LANDSAT IMAGERY - SNOW SURVEYS 1975-1978,

Pakistan Water and Power Development Authority, Lahore.
R. N. Tarar.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 177-190, 4 fig, 3 tab, 12 ref.

Descriptors: *Snowmelt, *Snow accumulation, *Runoff, Hydrology, Watersheds, Alpine regions, Snow, Remote sensing, Satellite technology, Snow, Pakistan, Mathematical analysis.

A study was initiated by the Pakistan Water and Power Development Authority in 1975 to evolve prediction techniques using Landsat imagery acquired for selected areas over the upper Indus basin. Through analysis and interpretation of snow cover and runoff data from 1975-1978, a simple predictive correlation of type $R = aA + b$ was developed where A is areal extent of snow cover in March and April, and R is the resultant runoff from March 1 to August 31 (snowmelt season). Attempts to test the procedure in actual practice, and the difficulties introduced by the presence of glaciers, are discussed. (See also W86-05610) (Halterman-PTT)
W86-05630

WMO PROJECT FOR THE INTERCOMPARISON OF CONCEPTUAL MODELS OF SNOWMELT RUNOFF,

World Meteorological Organization, Geneva (Switzerland).
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 193-202, 4 tab, 4 ref.

Descriptors: *Snowmelt, *Runoff, *Model studies, Snow accumulation, Hydrological aspects, Alpine regions, Watersheds, Ice, Snow, Snow surveys.

Eleven models of snowmelt runoff from eight countries were fitted to six standard sets of data submitted by six countries. Each data set comprises a six-year calibration period, for which the modellers are supplied with sets of input and output data, followed by a four-year period for which only the input data are provided. The project includes not only a comparison of the outputs of the models but also a comparison of their structures and the values they use for various parameters. The output from the various models is not presented here, but is scheduled to be presented in subsequent publications. (See also W86-05610) (Halterman-PTT)
W86-05631

LARGE-SCALE ASSESSMENT OF SNOW RESOURCES FOR FORECASTING SPRING FLOW,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
G. Balint, and P. Bartha.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 203-208, 2 fig, 4 ref.

Descriptors: *Snowmelt, *Runoff, *Snow accumulation, Hydrology, Water resources management, Alpine regions, Snow, Snow surveys, Model studies, Danube River, Alps, Carpathian Mountains, Hungary.

Data processing is described for operational snow data of the Danube basin. A schematic linear distribution of snow depths and water equivalent with elevation, is used on the basis of data for a ten year period. Under the conditions prevailing in the Alps and the Carpathians, the spring flow of most of the tributaries of the Danube is determined by the water resources stored in the snow cover of the mountainous parts of their basins at the end of the

accumulation period. The data processing methodologies and analytical procedures described are applied weekly for the assessment of the snow extent in three areas of the Danube and seven areas of the Tisza basins. (See also W86-05610) (Halterman-PTT)
W86-05632

METHODS OF REGIONAL COMPUTATION OF GLACIER MELTING INTENSITY IN CENTRAL ASIA,

Sredneaziatskii Nauchno-Issledovatel'skii Gidrometeorologicheskii Inst., Tashkent (USSR).
V. G. Konovalov.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 209-220, 2 fig, 3 tab, 17 ref.

Descriptors: *Glaciers, *Runoff, *Snowmelt, Water resources development, Alpine regions, Glaciohydrology, Snow management, Ice, Mathematical analysis, Heat balance equation, Radiation.

Analysis was made to obtain an optimal method for the computation of daily melting intensity for glaciers in mountainous river basins from limited initial information. Simplified forms of the heat-balance equation, and local and regional empirical formulae are considered. Comparison of the results of melting intensity at a number of Central Asian glaciers has revealed practically identical estimates of accuracy (root-mean-aquare deviation, relative error). Regional single- and two-factor formulae for the daily intensity of snow and ice melting in Central Asia are proposed. Absorbed radiation and air temperature are the arguments in these expressions. The variability of a single-factor formula parameter is represented as a function of altitude and time. (See also W86-05610) (Author's abstract)
W86-05633

SENSITIVITY OF THE EUROPEAN HYDROLOGICAL SYSTEM SNOW MODELS,

Institute of Hydrology, Wallingford (England).
E. M. Morris.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982. Exeter, England. p 221-2231, 1 tab, 15 ref.

Descriptors: *Snowmelt, *Hydrology, *Model studies, *Water resources development *Alpine regions, Snow management, Ice, Model studies, Watersheds, Snow, Snow surveys, Snow accumulation, European Hydrological System, Cairngorm Mountains, Scotland, Switzerland, Mathematical analysis.

Three point snow melt models for use with the European Hydrological System are based on the degree-day method, the energy-budget method, and full solutions of the equations of flow of mass and energy in a snow-pack. Field data for verification and sensitivity testing were from two sites. The first, a sub-arctic site in the Cairngorm Mountains of Scotland was on a moderate slope, facing northwest with predominant heather vegetation. The second, high-alpine site, lies on the north face of the Riffelberg in Switzerland with no vegetation. (See also W86-05610) (Halterman-PTT)
W86-05634

FACTORS AFFECTING RECESSION PARAMETERS AND FLOW COMPONENTS IN ELEVEN SMALL PRE-ALP BASINS,

Technical Univ. of Lisbon (Portugal). High Inst. of Agronomy.
L. S. Pereira, and H. M. Keller.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982. Exeter, England. p 233-242, 1 fig, 9 tab, 11 ref.

Descriptors: *Model studies, *Hydrological aspects, *Watersheds, Hydrology, Alpine regions, Mountains, Discharge hydrographs, Runoff, Water management, Mathematical analysis, Regression analysis, Statistical analysis.

Basin discharge is characterized during the growing season in eleven small basins of the Pre-Alps by master recession curves that have been adjusted by exponential recession equations with three terms which give the discharge as a function of the recession coefficients and of the initial discharge component. Three flow components are included: direct flow (which includes surface runoff and interflow), subsurface flow and baseflow. Using a multiple regression analysis, the influence of basin characteristics on the recession parameters and on flow component volumes were studied. The results show the main influence of hydrogeological factors on subsurface and baseflow characteristics as well as the contribution of vegetation and geomorphological factors to recession. (See also W86-05610) (Halterman-PTT)
W86-05635

RECESSION CHARACTERIZATION OF SMALL MOUNTAIN BASINS, DERIVATION OF MASTER RECESSION CURVES AND OPTIMIZATION OF RECESSION PARAMETERS,

Technical Univ. of Lisbon (Portugal). High Inst. of Agronomy.
For primary bibliographic entry see Field 2E.
W86-05636

NATURAL DAMS AND OUTBURST FLOODS OF THE KARAKORAM HIMALAYA,

Wilfrid Laurier Univ., Waterloo (Ontario).
K. Hewitt.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982. Exeter, England. p 259-269, 4 fig, 6 tab, 12 ref.

Descriptors: *Glaciers, *Glaciohydrology, *Glacier lakes, *Floods, Reservoir, Satellite technology, Remote sensing, Alpine regions, Mountains, Runoff, Hydrology, Karakoram Himalaya.

Glacier dams and related events are discussed in relation to regional environment considering the widespread potential for these glacier dams and resulting catastrophic outbursts. Some data are given on the dimensions of past dams and the nature and impact of flood waves. No dams were reported from the mid-1930's until 1978 when satellite imagery showed a 6 sq km glacier lake on Upper Yarkland. The absence of dams in recent decades relates to a general glacier recession in the Karakoram Himalaya. (See also W86-05610) (Halterman-PTT)
W86-05637

CHARACTERISTICS OF GLACIAL HYDROLOGY IN THE MOUNT TOMUR AREA OF CHINA,

Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
K. Ersi, Z. Shousen, and H. Mingmin.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982. Exeter, England. p 271-283, 5 fig, 6 tab, 1 ref.

Descriptors: *Glaciers, *Glaciohydrology, *Runoff, *Ablation, Alpine regions, Mountains, Runoff hydrographs, Hydrological aspects, Mt. Tomur, China.

The glaciers in the Mt. Tomur area of China not only provide a rich source of material for ablation, but also have conditions favoring ablation, to produce a great volume of meltwater runoff. The variations of the radiation balance and the air temperature coincide with that of the runoff volume from the surface ablation. The runoff volume is greatest in the months of June, July and August. The runoff comes mainly from the surface ablation of the accumulation area, and finally from internal ablation and other types of ablation of the tongues. The type of alimentation of the rivers in the area belongs basically to the mixed one of glacial meltwater and rainfall. The alimentation of the rivers by glacial meltwater takes place dominantly in the southern and eastern parts of the area. The daily fluctuation of the glacier runoff is smaller than that of some other types of glaciers, and the runoff does not stop even in winter. The annual distribution of runoff is extremely non-uniform, but the variation is small from year to year. (See also W86-05610) (Author's abstract)
W86-05638

STUDY ON THE VARIATION COEFFICIENT OF ANNUAL RUNOFF OF THE RIVERS IN NORTHWEST CHINA,

Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
For primary bibliographic entry see Field 4A.
W86-05639

BASIC CHARACTERISTICS OF RUNOFF IN GLACIERIZED AREAS IN CHINA,

Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
Y. Zhenniang.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982. Exeter, England. p 295-307, 5 fig, 4 tab, 8 ref.

Descriptors: *Glaciers, *Runoff, *Glaciohydrology, Discharge hydrographs, Alpine regions, Mountains, Hydrological aspects, China.

Starting with the analysis of the basic regularity of glacier ablation, this paper approaches the relationship between glacier ablation and changes of stream runoff, and the regional regularity of basic characteristic values of glacial hydrology in glacial areas, and then puts forward the idea that the amount of glacier meltwater in the areas where no data are available may be estimated by means of the regional regularity of the net glacier runoff modulus. In the course of the research, the author mainly made use of the hydrological and meteorological data accumulated by alpine stations (or sites) for the past twenty years or more as well as the basic data derived from the hydrological stations in the neighboring regions. (See also W86-05610) (Author's abstract)
W86-05640

EFFECTS OF CROSS DYKES ON ALTERNATE BARS,

Public Works Research Inst., Tsukuba (Japan).
For primary bibliographic entry see Field 2J.
W86-05641

DYNAMICS OF SUSPENDED SEDIMENT CONCENTRATION IN AN ALPINE PRO-GLACIAL STREAM NETWORK,

Southampton Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W86-05642

WATER AND NUTRIENT DISCHARGE DURING SNOWMELT IN SUBALPINE AREAS,

Swiss Forest Research Inst., Birmensdorf.
H. M. Keller, and T. Strobel.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982. Exeter, England. p 331-341, 4 fig, 6 tab, 8 ref.

Descriptors: *Snowmelt, *Nutrients, *Hydrological aspects, Stream discharge, Streamflow, Hydrology, Phosphates, Nitrates, Ammonia, Land use, Switzerland.

Hydrological data from six small subalpine basins in Switzerland are analyzed to study water and nutrient discharge during snowmelt as affected by forest cover and weather conditions in winter. Streamflow from March through April varies between 300 and 900 mm and is usually 40% or more

of the annual flow. It decreases as forest cover increases. For average winter conditions this is at a rate of about a 4 mm decrease of spring streamflow for every percent increase of forest cover. Flow-weighted nutrient concentrations tend to be similar in the three basins used in this study: 00.16 to 0.29 mg NO3-N/1, 0..02 to 0.03 mg NH4-N/1, 0.016 to 0.029 mg PO4-P/1. The loads during the snowmelt season (March-May) follow the trends set by streamflow and range from 1.4 to 2.9 kg NO3-N/ha, 0.2 to 0.3 kg NH4-N/ha, and 0.1 to 0.2 kg PO4-P/ha. The wide range of nitrate loads is due to the basin with large areas of pasture and grassland yielding about twice the load of the forested basins. (See also W86-05610) (Author's abstract)
W86-05643

HYDROLOGICAL ASPECTS OF EROSION ON MOUNTAINOUS TERRAIN - AN EXAMPLE FROM THE HIMALAYAN REGION, INDIA, BASED ON PHOTO-INTERPRETATION,

Indian Photo-Interpretation Inst., Dehra Dun.
For primary bibliographic entry see Field 2J.
W86-05644

USING THE DWOPER ROUTING MODEL TO SIMULATE RIVER FLOWS WITH ICE,

Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 8B.
W86-05795

FLOW RESISTANCE OF RIVER ICE COVER,

Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
H. T. Shen, and P. D. Yapa.
Journal of Hydraulic Engineering (ASCE)JHEND8, Vol. 112, No. 2, p 142-156, February 1986. 11 fig, 3 tab, 16 ref. Army Contract DACA89-84-K-0008.

Descriptors: *Flow, *Retarded flow, *Ice cover, *River ice, Floating ice, Model Studies, Hydraulic models, Rivers, Ice, St. Lawrence River, Weather.

An empirical model was developed for describing the time-dependent variation of the hydraulic resistance coefficient of a river's ice cover as a function of weather and flow conditions. The resistance coefficient consists of 3 components: 1) a main component that increases monotonically during the freeze-up period and decreases monotonically during the rest of the ice-covered period; 2) a minor component that represents the ice-covered season; and 3) a fluctuation component that represents the effect of the transport, deposition, and erosion of frazil ice produced in the upstream open water areas during the ice-covered period. The empirical model is formulated by considering major physical processes that affect the hydraulic resistance of the ice cover and the field data for a reach of the upper St. Lawrence River. With additional applications of the present model concept to other rivers, a generalized model for hydraulic resistance of river ice cover may be developed. (Master-PTT)
W86-05818

SULFATE AND NITRATE CONCENTRATIONS FROM A SOUTH GREENLAND ICE CORE,

New Hampshire Univ., Durham. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-05949

DOWNSTREAM TRANSITION OF RIVER ICE JAMS,

National Water Research Inst., Burlington (Ontario).
S. Beltaos, and J. Wong.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 112, No. 2, p 91-110, February 1986, 9 fig, 4 tab, 18 ref.

Descriptors: *Rivers, *Ice jams, Granular mass theory, Thames River, Athabasca River, Numerical algorithm, Predictive model, Canada.

The granular mass theory of river ice jams was extended to their downstream transition as a means of improving understanding of conditions at jam toe. The theory is coupled with the equations of motion under, and seepage through, the jam and the resulting differential equations are solved numerically. The model applies to wide rectangular channels under steady flow conditions and involves several coefficients whose precise values are unknown. Sample calculations illustrate the sensitivity of the model to the various coefficients. Preliminary application of the model to two case studies (Thames and Athabasca Rivers in Canada) resulted in plausible findings with regard to the grounding of ice jams. It is suggested that these findings could find application in the design of measures to prevent or remove destructive ice jams. (McFarlane-PTT)
W86-05984

MESOSCALE NUMERICAL FORECAST OF AN INTENSE CONVECTIVE SNOWBURST ALONG THE EAST COAST,

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center.
P. J. Kocin, L. W. Uccellini, J. W. Zack, and M. L. Kaplan.
American Meteorological Society Bulletin, Vol. 66, No. 11, p 1412-1424, November 1985. 9 fig, 31 ref.

Descriptors: *Weather forecasting, *Numerical analysis, *Snow, Washington DC, Baltimore, Maryland, Simulation analysis, Model studies.

Documentation for a mesoscale numerical forecast, utilizing the Mesoscale Atmosphereic Simulation System (MASS), for a convective snowburst in the Washington, DC-Baltimore, Maryland region on March 8, 1984 is presented. This storm was associated with a secondary cyclogenesis along the East Coast. The forecasts were presented to demonstrate the ability of a mesoscale model to simulate dynamic interactions and diabatic processes for a wintertime convective event which was inadequately predicted by local forecasters and to note some of the possible benefits of using mesoscale models for day-to-day forecasting. The results from this and other recent mesoscale modeling studies indicate that three-hourly output of key model fields, when combined with other data sources, can be a valuable aid to forecasters concerned with predicting weather events that are mesoscale in character. (Jones-PTT)
W86-06102

2D. Evaporation and Transpiration

DETERMINATION OF THE LATENT HEAT FLUX IN FOG,

Istituto di Fisica dell'Atmosfera, Rome (Italy).
For primary bibliographic entry see Field 2B.
W86-05497

EVAPOTRANSPIRATION OVER AN AGRICULTURAL REGION USING A SURFACE FLUX/TEMPERATURE MODEL BASED ON NOAA-AVHRR DATA,

Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
O. Taconet, R. Bernard, and D. Vidal-Madjar.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 3, p 284-307, March 1986. 16 fig, 5 tab, 33 ref.

Descriptors: *Evapotranspiration, *NOAA-7 Satellite, *Infrared surface data, Soil moisture, Distribution, *Temperature, Mathematical model, Beauce, France, Vegetation, Boundary layer.

Infrared (IR) surface temperatures from satellites (NOAA, GOES) have been used extensively for inferring daily evaporation and soil moisture distribution over large areas (100 TO 100,000 sq km). The authors have developed a methodology, using IR surface data from NOAA-7 as input data, in a one-dimensional boundary layer/vegetation/soil model, including parameterization of transfers within the canopy, based on the formulation of Deardorff, which allows the use of a small number mesoscale surface temperature measured near midday (provided by NOAA-7) is sufficient for obtaining the surface energy fluxes over dense vegetation and for deriving the only governing parameter that remains: the bulk canopy resistance to evaporation, a different concept from moisture availability used over bare soils. The objective of the model in predicting the area-averaged surface fluxes and canopy resistance over dense vegetation is analyzed in conjunction with experimental surface fluxes for three cases with cloudless NOAA images over a flat monocultural region (the Beauce in France). In the absence of a current capability for routine daily soil moisture observation over an agricultural region, an area-averaged evaluation of the soil moisture can be derived from the canopy resistance obtained by this methodology. (Rochester-PTT)
W86-05549

PRACTICAL ESTIMATES OF LAKE EVAPORATION,

National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2H.
W86-05551

RESERVOIR STORAGE YIELD ANALYSIS FOR ARID AND SEMIARID CLIMATES,

Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4A.
W86-05755

HAPEX-MOBILHY: A HYDROLOGIC ATMOSPHERIC EXPERIMENT FOR THE STUDY OF WATER BUDGET AND EVAPORATION FLUX AT THE CLIMATIC SCALE,

American Meteorological Society, Boston, MA.
For primary bibliographic entry see Field 2B.
W86-05847

EVAPOTRANSPIRATION OF SMALL CONIFERS,

Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
M. R. Petersen, and R. W. Hill.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 111, No. 4, p 341-351, December 1985. 5 fig, 3 tab, 9 ref.

Descriptors: *Evapotranspiration, *Conifers, Trees, Consumptive use, Crop Production, Water use, Scotch pines, Lysimeters, Logan, Utah, Mathematical equations, Mathematical analysis, Irrigation, Precipitation.

Three lysimeters were established containing different sized Scotch pines (P. sylvestris), and the consumptive water use of each tree was monitored during the 1982 and 1983 growing seasons near Logan, UT. Weather data including maximum, mean, and minimum daily temperatures, solar radiation, and daily precipitation were collected. Consumptive use data of the first season was of limited use due to the transplanting stress experienced by the trees. The results of the second season were consistent with the usual water use of irrigated crops. Mean monthly crop coefficients were calculated based on the modified equations, and assuming water was extracted from only the crown projection area of the tree. A seasonal crop coefficient was estimated to be 1.22. The growing season was long, allowing crop coefficients during the winter at this site to be as high as 0.85. An equation was developed to find the composite crop coefficient for conifer tree farms relating tree size, tree spacing, and type of ground cover. (Doria-PTT)
W86-05918

EVAPOTRANSPIRATION MODEL FOR SEMI-ARID REGIONS,

Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
P. K. Jain, and G. Sinai.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 111, No. 4, p 369-379,

December 1985. 4 fig, 2 tab, 15 ref.

Descriptors: *Evapotranspiration, *Semiarid climates, *Water management, Bananas, DRAINMOD, Thornthwaite equation, Model studies, Mathematical equations, Lysimeters.

The Thornthwaite method for calculating evapotranspiration (ET) as used in the water management model, DRAINMOD, was modified for semiarid conditions since for such conditions the existing method had underestimated the average monthly ET rate by about 50%. The three modifications were: (1) increase the constant in the Thornthwaite general equation depending upon the min-max range of the annual mean air temperature wave; (2) shift the daylight hours wave by 45 days and bring it parallel to the mean air temperature wave. This shift is made in order to account for the heat energy of the atmosphere surrounding the plants; and (3) do not equate the actual evapotranspiration (AET) to zero during irrigation. The AET was measured in a drip irrigated banana field with lysimeters. The simulated monthly adjusted values of AET give satisfactory estimates with an average error of within plus or minus 10% when compared to that of the lysimeter data. (Doria-PTT)
W86-05920

WATER TRANSFER BY PLANT ROOTS FROM WET TO DRY SOIL,

Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
C. H. M. van Bavel, and J. M. Baker.
Naturwissenschaften, Vol. 72, No. 11, p 606-607, November 1985. 2 fig, 1 tab, 7 ref.

Descriptors: *Soil-water-plant relationships, *Plant roots, *Soil, Bermuda grass, Water potentials, Irrigation practices, Soil water potential.

The uptake of water by plant roots from the soil occurs in response to a hydraulic gradient that exists between the fluid in the water-bearing xylem tissue of the plant and the liquid in the soil. If this gradient reversed, xylem sap would flow out of the roots into the soil, and a root system that connects soil regions with differing water potential would serve as a conduit for a corresponding fluid flow. A direct experiment shows that water exudation by roots can occur in significant amounts, and that it can be accurately predicted. This indicates that technologies of crop irrigation, such as drip irrigation, alternate furrow irrigation, or subirrigation, should be reconsidered. It suggests that deeper roots can support functioning of shallower ones in the upper and driest part of the root zone. Simulation models of root water uptake by vegation, now widely used in agronomy and hydrology, should take water transfer by roots within the soil into account. (McFarlane-PTT)
W86-05964

STATISTICAL ANALYSIS OF THE RELATIONSHIPS AMONG RAINFALL, OUTGOING LONGWAVE RADIATION AND THE MOISTURE BUDGET DURING JANUARY-MARCH 1979,

Hawaii Univ., Honolulu. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W86-06055

TIME DEPENDENT THREE DIMENSIONAL SIMULATION OF FLOWS IN SHALLOW DOMAINS WITH VEGETATIVE OBSTRUCTION,

Miami Univ., Coral Gables, FL. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 4A.
W86-06065

2E. Streamflow and Runoff

PALEOFLOOD HYDROLOGY AND FLOOD FREQUENCY ANALYSIS,

Institute of Hydrology, Wallingford (England).
J. R. M. Hosking, and J. R. Wallis.
Water Resource Research WRERAO, Vol. 22, No. 4, p 543-550, April, 1986. 7 fig, 4 tab, 31 ref.

Descriptors: *Rivers, *Flood frequency, *Paleohydrology, Model studies, Hydrology.

Techniques recently developed in paleohydrology permit the estimation of discharges and dates of occurrence of flood events which occurred thousands of years ago. Computer simulation was used to assess whether a single paleoflood estimate, when included in a single-site or regional flood frequency analysis procedure, gives a worthwhile increase in the accuracy of estimates of extreme floods. The main factors involved are the specification of the fitted flood frequency distribution (whether it has two or three unknown parameters) and the size of the measurement error of paleodischarge estimates. Errors in estimating the date of the paleoflood are not important. Paleological information is most useful when estimating a three-parameter flood frequency distribution from a short gaged record for a single site or a small number of homogeneous sites. Even when the estimate of the paleological maximum event is subject to an error of +- 50%, the accuracy of extreme flood estimates is improved. (Cassar-PTT)
W86-05434

CHANCE-CONSTRAINED MODEL FOR REAL-TIME RESERVOIR OPERATION USING DROUGHT DURATION CURVE,

Yamanashi Univ., Kofu (Japan). Dept. of Environmental Engineering.
K. Takeuchi.
Water Resources Research WRERAO, Vol. 22, No. 4, p 551-558, April, 1986. 7 fig, 16 ref, append.

Descriptors: *Rivers, *Reservoir operation, *Drought, Model studies, Hydrology, Drought duration curve, Mathematical studies, Water storage, Water supply, Fukuoka, Japan.

A chance-constrained model was developed for real-time operation of an existing single-purpose reservoir. The objective was to minimize the supply cut ratio (ratio of supply deficit to demand). The constraint was to make the probability of reservoir exhaustion always less than a specified allowable level. The allowable probability of reservoir exhaustion was considered dependent on time lead to its occurrence. By m. A seasonal drought duration curve was developed to evaluate an average inflow within a certain period starting from a certain time with a certain probability of failure. The model was shown to be practical and satisfactory by a simulation study of the Fukuoka, Japan, municipal water supply reservoirs during the 1977-1979 drought. (Cassar-PTT)
W86-05435

RATIO, TRANSMISSIVITY/STORATIVITY FROM ELECTRIC ANALOG VALUES OF STREAMFLOW,

James Madison Univ., Harrisonburg, VA. Dept. of Geology and Geography.
J. E. Sander.
Ground Water GRWAAP, Vol. 24, No. 2, p 152-156, March-April, 1986. 2 fig, 1 tab, 4 ref.

Descriptors: *Surface-groundwater relations, *Groundwater, *Streams, *Transmissivity, *Storativity, *Streamflow, Model studies, Virginia, Small watersheds, Watersheds, Hydrology, Electric analog models, Christians Creek, Shenandoah River, Aquifers.

Electric analog modeling techniques were used to estimate transmissivity and storativity from streamflow data in two small drainage basins in Virginia, Christians Creek and the north fork of the Shenandoah River. Steamflow modeling produced regional estimates of the ratio of transmissivity to storativity, which is larger than expected. This discrepancy was explained by assuming that the drainage basin contain only a small percentage of permeable rock, estimated at 0.1-1%. Conversely, the model can be used to estimate the percent of permeable rock in a watershed. (Cassar-PTT)
W86-05440

LIMESTONE INFLUENCES ON PHYSICAL AND CHEMICAL FEATURES OF A MOUNTAIN STREAM,

Oregon State Univ., Corvallis. School of Forestry.
For primary bibliographic entry see Field 2K.
W86-05442

SECONDARY PRODUCTION, EMERGENCE, AND EXPORT OF AQUATIC INSECTS OF A SONORAN DESERT STREAM,

Arizona State Univ., Tempe. Dept. of Zoology.
For primary bibliographic entry see Field 2I.
W86-05451

GENERAL EXPRESSION OF BASIN LAG TIME,

Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
W. E. Watt, and K. C. Ander Chow.
Canadian Journal of Civil Engineering CJCEB, Vol. 12, No. 2, p 294-300, June 1985. 2 fig, 4 tab, 18 ref.

Descriptors: *Rainfall-runoff relationships, *Peak discharge, *Basin lag time, *Mathematical equations, Flood peak, Precipitation, Basin length, Basin slope, Storage, Lakes, Swamps, Hydrologic models, Watersheds.

Basin lag time is an important variable in the calculation of peak discharge resulting from a specified precipitation input. For the case of ungauged basins, the lag time must be estimated, normally from one or more expressions relating lag time to basin physical characteristics. A number of such expressions exist, but each was developed for a particular range of basin size and geographic region. To overcome the problem of using an expression for basin lag time has been developed using data from basins representative of many regions in North America and ranging in area from 0.5 ha to 5,840 sq km. The tentative expression has only one basin characteristic, basin length divided by the square root of basin slope, L/square root of S, and applies to natural basins with minimal effective lake and swamp storage. It has not been tested for very flat basins (basin slope <0.001 m/m) and may not apply in these cases. It also may not apply for either very small or very large precipitation events. (Rochester-PTT)
W86-05470

MEANING OF OSCILLATIONS IN UNIT HYDROGRAPH S-CURVES,

Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Hydrological Sciences Journal HSJODN, Vol. 30, No. 3, p 331-342, September, 1985. 7 fig, 1 tab, 10 ref.

Descriptors: *Hydrographs, *Unit hydrographs, *Rainfall-runoff relationships, S-Curves, Flood Flow, Mathematical studies, Differential equations.

The unit hydrograph has been used extensively to predict flood flows in rivers. This study used the Duhamel superposition integral to obtain some exact solutions for unit hydrograph applications. These equations and numerical examples are used to show that oscillations occur in an S-curve when the time step is less than the excess rainfall duration if the measured hydrograph differs from a hydrograph that was obtained by solving a linear differential equation with time-dependent coefficients. S-curve oscillations gave a qualitative indication of the suitability of unit hydrograph theory for predicting flood flows in rivers. Since an instantaneous unit hydrograph (IUH) is calculated from the slope of an S-curve, oscillations in an S-curve will lead to even larger oscillations in an IUH. (Main-PTT)
W86-05533

SOURCE OF ERROR IN WATER VELOCITY MEASUREMENT FOR AQUATIC STUDIES,

Department of Fisheries and Oceans, Halifax (Nova Scotia).

For primary bibliographic entry see Field 7B.
W86-05564

HYDROLOGICAL ASPECTS OF ALPINE AND HIGH-MOUNTAIN AREAS.

Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2C.
W86-05610

MAPS OF STREAMFLOW RESOURCES OF SOME HIGH-MOUNTAIN AREAS IN ASIA AND NORTH AMERICA,

Akademiya Nauk SSSR, Moscow. Inst. Geografii.
N. N. Dreyer, G. M. Nikolayeva, and I. D. Tsigelnaya.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 11-20, 9 fig.

Descriptors: *Snow, *Ice, *Hydrologic maps, *Streamflow, Hydrologic budget, Alpine regions, Mountains, Precipitation, Rainfall, Discharge hydrographs, Tien Shan, Pamirs, Hindu-Kush, Karakoram, Rocky Mountains.

Various aspects of compiling maps of streamflow and its genetic components in high-mountain areas to determine the snow and ice resources of the world are discussed. The discussion is illustrated with graphical relations and maps of the Tien Shan, Pamirs, Hindu-Kush, and Karakoram in Asia and the Rockies in North America. These maps make it possible to assess dynamic and potential water resources of different origin with a view to their rational use and conservation, and their quantitative and qualitative forecasting and management. (See also W86-05610) (Halterman-PTT)
W86-05612

HYDROLOGICAL RELATIONSHIPS IN A GLACIERIZED MOUNTAIN BASIN,

Inland Waters Directorate, Ottawa (Ontario).
G. J. Young.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 51-59, 4 fig, 1 tab, 13 ref.

Descriptors: *Runoff, *Glaciers, *Alpine regions, *Hydrological aspects, Mountains, Snow, Ice, Discharge hydrographs, Flow rates.

A description is given of the runoff from a small highly glacierized basin for an eight-year period. Components of total runoff are estimated for glacier ice and firn, seasonal snow-packs and summer precipitation. While the presence of the glacier is seen to have a regulatory influence on total runoff and the progression of events is similar from one year to another, the timing of events is markedly different, resulting in summer hydrographs of quite different shapes. The interplay between terrain types, precipitation events and energy receipt is complex. The response time of the basin and the relative importance of ice and firn melt to total flow is closely linked to the timing of the progression of the transient snowline up the glacier. (See also W86-05610)(Author's abstract)
W86-05616

VARIATIONS OF THE HYDROLOGICAL PROPERTIES OF ALPINE SNOW-COVER STORES,

Technische Univ. Braunschweig (Germany, F.R.). Lehrstuhl fuer Physische Geographie und Landschaftsokologie.
For primary bibliographic entry see Field 2C.
W86-05620

GLACIER DISCHARGE MODEL BASED ON RESULTS FROM FIELD STUDIES OF ENERGY BALANCE, WATER STORAGE AND FLOW,

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Strahlenschutz.
For primary bibliographic entry see Field 2C.
W86-05621

IMPORTANCE OF THE STRUCTURE OF THE GLACIER INTERNAL AND EXTERNAL RUNOFF SYSTEM OF CHANNELS AND STREAMS TO GLACIER ACTIVITY,

Akademiya Nauk SSSR, Moscow. Inst. Geografii.
For primary bibliographic entry see Field 2C.
W86-05623

MODELING RUNOFF FROM A GLACIERIZED BASIN,

Norges Vassdrags- og Elektrisitetsvesen, Oslo.
For primary bibliographic entry see Field 2C.
W86-05624

ASSESSING SNOW STORAGE AND MELT IN A NEW ZEALAND MOUNTAIN ENVIRONMENT,

Otago Univ., Dunedin (New Zealand). Dept. of Geography.
For primary bibliographic entry see Field 2C.
W86-05628

WMO PROJECT FOR THE INTERCOMPARISON OF CONCEPTUAL MODELS OF SNOWMELT RUNOFF.

World Meteorological Organization, Geneva (Switzerland).
For primary bibliographic entry see Field 2C.
W86-05631

FACTORS AFFECTING RECESSION PARAMETERS AND FLOW COMPONENTS IN ELEVEN SMALL PRE-ALP BASINS,

Technical Univ. of Lisbon (Portugal). High Inst. of Agronomy.
For primary bibliographic entry see Field 2C.
W86-05635

RECESSION CHARACTERIZATION OF SMALL MOUNTAIN BASINS, DERIVATION OF MASTER RECESSION CURVES AND OPTIMIZATION OF RECESSION PARAMETERS,

Technical Univ. of Lisbon (Portugal). High Inst. of Agronomy.
L. S. Pereira, and H. M. Keller.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982. Exeter, England. p 243-255, 4 fig, 3 tab, 18 refs.

Descriptors: *Model studies, *Hydrologic aspects, *Recession curves, *Watersheds, Hydrology, Alpine regions, Discharge hydrographs, Runoff, Water management, Hydrologic budget, Statistical analysis.

Master recession curves of small mountain basins and of estimating the parameters of compound recession laws correspond to average recession conditions. They are derived by: (a) analyzing all observed depletion curves; (b) adjusting their segments with a simple recession law; (c) grouping these segments according to their parameters; (d) characterizing these groups with the mean values of the recession parameters, and (e) representing the master recession curves by the sequence of these calculated recession segments. Utilizing a weighted least-squares method for solving nonlinear equations, the optimization of recession parameters includes: (a) computerized estimation of the initial set of parameters; (b) a procedure to check the parameter values, and (c) use of particular techniques to improve calculation. (See also W86-05610) (Author's abstract)
W86-05636

BASIC CHARACTERISTICS OF RUNOFF IN GLACIERIZED AREAS IN CHINA,

Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
For primary bibliographic entry see Field 2C.
W86-05640

HYDROLOGICAL ANALYSIS FOR THE PLANNING OF SMALL HYDROPOWER PLANTS,

H. P. Nachtnebel.
IN: Symposium on Project Design and Installation of Small Hydro Power Plants, Vienna, Austria, June 29-July 1, 1981. p 59-80, 12 fig, 15 tab, 21 ref.

Descriptors: *Hydrologic aspects, *Hydrologic data, *Water resources development, *Planning, *Hydroelectric plants, Hydroelectric power, Measuring instruments, Water management, Flow measurement, Runoff rates.

In general it may be said that the quality of necessary hydrological values is dependent on the quality of the observed material. The quality of data depends upon the frequency of measuring stations, the time scale of resolution of the measuring instruments, the length of observation and the accuracy of observation. The better the raw data, the more simple the evaluation methods. Consequently, in cases of limited information, specific methods and more extensive investigations are necessary. In each chapter, appropriate methods for analysis are described when sufficient data from the project sites are available. Following that, special attention is given to the transposition of data and regionalization, if documentation is scarce or exists only for other measuring stations. For the planning of small hydropower plants as well as for their operation basic hydrological values have to be determined. The basic design data contains the determination of the average annual runoff as well as the rate of discharge, the high and low flow statistics and the plotting of duration curves. According to the availability of runoff and precipitation observations, differrent methods can be applied, each of which are explained with examples. (See also W86-05734) (Lantz-PTT)
W86-05737

ANALYSIS OF THE TANANA RIVER BASIN USING LANDSAT DATA,

National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
For primary bibliographic entry see Field 7B.
W86-05745

FLOW RESISTANCE OF RIVER ICE COVER,

Clarkson Coll. of Technology, Potsdam, NY. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2C.
W86-05818

GENERAL FORMULA FOR CALCULATING THE PROBABILITY OF FAILURE OF WATER PROJECTS AND ITS POTENTIAL APPLICATIONS,

East China Technical Univ. of Water Resources, Nanjing.
For primary bibliographic entry see Field 8A.
W86-05836

INFLOW SEEPAGE INFLUENCE ON STRAIGHT ALLUVIAL CHANNELS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. R. Richardson, S. R. Abt, and E. V. Richardson.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 8, p 1133-1147, August 1985, 8 fig, 3 tab, 11 ref.

Descriptors: *Surface-groundwater relations, *Channel inflow, *Alluvial Channels, *Flumes, *Seepage, Influent Seepage, Flow, Scour, Bed Form, Sediment Transport, Flow resistance, Channel morphology, Channels.

The effect of inflow seepage on energy slope, water surface depth, velocity, sediment transport, scour, bed forms, and resistance to flow was investigated using a flume. Inflow seepage increases localized mean channel velocity, energy slope, and stream power in the zone of inflow. The water

surface depth decreased for subcritical flow and remained nearly constant for supercritical flow during inflow conditions. Sediment transport was slightly increased when in flow was introduced in the bed. Inflow seepage did not appear to enhance channel scour but significantly enhanced bed form transformation and the bed roughness. Inflow seepage also caused dunes to become longer, flatter, and move more erratically in the reach where inflow occurred. Inflow seepage can significantly influence the channel hydraulics, stream power, bed form and bed roughness in the localized zone of inflow. (Author's abstract)
W86-05855

DETERMINATION OF RIPPLE GEOMETRY,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
M. S. Yalin.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 8, p 1148-1155, August 1985. 4 fig, 10 ref, append.

Descriptors: *Ripple geometry, *Channel morphology, Flow, Channel flow, Ripples, Physical models, Sediment transport, Bed load.

Laboratory measurements were carried out using adjustable slope flumes on mobile bed covered by ripples generated by an open channel flow. The bed materials used were cohesionless and reasonably uniform silica; the steady-state subcritical flume flow was in equilibrium and it was nearly two-dimensional. In addition to the conventional runs conducted with water, special runs were conducted with a water and glycerine mixture. Using the results of these measurements, as well as the data of other sources, a series of experimental curves were determined which can be to predict the length and height of ripples. The analysis of the data indicates that the dimensionless quanitities related to the geometry of ripples are functions of two dimensionless variables. One of them must be a combination reflecting the intensity of sediment-transporting flow, the other must be an arrangement of parameters characterizing the physical nature of the liquid and solid phases involved. (Jones-PTT)
W86-05856

PREDICTION OF 2-D BED TOPOGRAPHY IN RIVERS,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 2J.
W86-05858

ESTIMATION OF HYDRAULIC DATA BY SPLINE FUNCTIONS,
Kanazawa Inst. of Tech. (Japan). Dept. of Civil Engineering.
K. Mizumura.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 9, and p 1219-1225, September 1985. 8 fig, 5 ref.

Descriptors: *Spline functions, *Mathematical studies, *Data analysis, *Hydraulics, Data aquisition, Flow discharge, Sediment discharge, Simulation, Sediment yield, Mathematical analysis, Error analysis.

In hydraulics, methods are needed to estimate (interpolate) missing data of various processes. This paper presents a method for using the 'Spline Functions.' For illustration, the method was applied to the generation of missing sediment data. With this estimation method, it is possible to reduce the data requirement. Since observed data are scattered in all the obersvation periods, all information on the observed data can be used to estimate the unknown data at the same time. Without measuring sediment concentration in rivers every day, good information for unmeasured data can be found by using the cubic spline functions, the derivation of which is shown in a series of equations. The cubic spleen functions were applied to sediment data on the Trinity River in California to obtain the relationship between the amount of data used and the accuracy of interpolation by the cubic spleen functions. There was a large difference in the estimation error between 20% and 30% usage of all data. The sample time is dependent on the time scale of the physical process. (Jones-PTT)
W86-05859

LARGE BASIN DETERMINISTIC HYDROLOGY: A CASE STUDY,
San Diego State Univ., CA. Dept. of Civil Engineering.
V. M. Ponce, Z. Osmolski, and D. Smutzer.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 9, p 1227-1245, September 1985. 9 fig, 5 tab, 51 ref.

Descriptors: *Hydrology, *Model studies, *River basins, *Rainfall-runoff relationships Santa Cruz, Arizona, Bridges, Simulated rainfall, Rainfall, Regulatory discharge, Design discharge, Hydrologic models, Flood plain management.

A case study of large basin hydrology was performed using the Santa Cruz River upstream of Cortaro Farms Bridge near Tucson, Arizona, drains 3,503 sq. miles. The evaluation uses techniques of deterministic hydrologic modeling to calculate frequency-based floods at proposed bridge improvement sites. A computer model capable of simultaneously handling the complex topology of the basin is driven by 100-yr frequency National Weather Service rainfall events of 24-, 48- and 96-hr durations. The model is calibrated using recorded rainfall-runoff data for the flood of October, 1983, which produced record flows throughout southeastern Arizon. A series of general and local storms were simulated. General storms cover the entire basin with low-intensity rainfall events. Local storms cover selected portions of the basin with high intensity rainfall events. Critical peak flows at the bridge sites are associated with a combination of general 24-hr and local 48-hr storms. The results of the simulation led Pina County to adopt revised flood discharges along the Santa Cruz River which are to be used for flood plain management and channel and bridge improvement and design. (Jones-PTT)
W86-05860

MACROINVERTEBRATE DRIFT IN THE MIDDLE COURSE OF THE RIVER DUNAJEC (SOUTHERN POLAND),
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 2H.
W86-05891

CHARACTERISTICS OF FREE SURFACE FLOW OVER GRAVEL BED,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
A. D. Gupta, and G. N. Paudyal.
Journal of Irrigation and Drainage Engineering, Vol. 111, No. 4, p 299-318, December 1985. 7 fig, 6 tab, 22 ref.

Descriptors: *Open-channel flow, *Flow profiles, *Flow characteristics, *Gravel, *Free surfaces, *Flow, Seepage, Hydraulics, Flow characteristics, Velocity distribution.

Measurements of velocity profiles of a free surface flow over a permeable gravel bed indicate that the logarithmic velocity distribution can be preserved if the reference datum is located a small distance equal to about one third of the median diameter of the bed particles below the surface. The observed value of 0.28 for the Karman constant is significantly reduced below the commonly expected value of 0.4 for impervious boundaries which indicates that the boundary resistance of the permeable bed is higher than that of the impermeable bed having identical rugosity. It is also observed that the friction factor increases with the increase in Reynolds number. A method is proposed to predict the amount of seepage flow through the permeable bed by measuring the hydraulic gradient and the velocity profile above the bed and the bed material properties such as grain size and permeability. Although the measured bed flow showed considerable deviations from the predictions for the present experiments, the proposed method can be usefully applied in practical problems. (Author's abstract)
W86-05915

RUNOFF PROBABILITY, STORM DEPTH, AND CURVE NUMBERS,
Utah State Univ., Logan. Dept. of Forest Resources.
For primary bibliographic entry see Field 2A.
W86-05917

DIMENSIONLESS FORMULATION OF FURROW IRRIGATION,
For primary bibliographic entry see Field 3F.
W86-05921

ROUGHNESS COEFFICIENTS FOR ROUTING SURFACE RUNOFF,
Agricultural Research Service, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2A.
W86-05926

LIFE CYCLES OF HYDROPSYCHE RIOLA, H. SLOSSONAE AND CHEUMATOPSYCHE PETTITI (TRICHOPTERA: HYDROPSYCHIDAE) IN A SPRING-FED STREAM IN MINNESOTA,
Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W86-05930

RESPONSE OF BAETIS MAYFLIES (EPHEMEROPTERA) TO CATCHMENT LOGGING,
Georgia Univ., Athens. Dept. of Entomology.
For primary bibliographic entry see Field 4C.
W86-05931

PREDATOR SPECIES RICHNESS AND PREY POPULATION VARIABILITY: EFFECTS ON DIETS OF BENTHIC STREAM FISHES,
Wisconsin Dept. of Natural Resources, Madison. Bureau of Fish Management.
For primary bibliographic entry see Field 2H.
W86-05932

STRUCTURE OF TURBULENCE IN COMPOUND CHANNEL FLOWS,
Ottawa Univ. (Ontario). Dept. of Civil Engineering.
P. Prinos, R. Townsend, and S. Tavoularis.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 9, p 1246-1261, September 1985, 18 fig, 1 tab, 16 ref. NSERC Canada Grant Co. A-7443.

Descriptors: *Turbulence, *Channel flow, *Flood flow, Sheer stress, Flood plain, Channel morphology, Berms, Mathematical models, Eddy diffusion.

The structure of turbulence in compound (multiple) channel flows was examined. Shear stresses and turbulence intensities were measured in a channel comprised of a deep central section flanked on either side by wide shallow berms (flood plains). The study concerns the nature of turbulence in the mixing regions separating the deep and shallow zones. The mixing region's effect on the compound flow field was also examined for both 'wide' and 'narrow' channel conditions. Under 'narrow' channel conditions the mixing process extends to the center of the main channel flow field; however, under 'wide' channel conditions, the central region is not affected and observed turbulence levels at the center of the main channel are in close agreement with theoretical values for a two-dimensional flow field. Apparent shear stress at the vertical main channel-flood plain interface was measured directly and compared favorably with estimated values based on momentum considerations. (Author's abstract)
W86-05965

OVERBANK FLOW WITH VEGETATIVELY ROUGHENED FLOOD PLAINS,

California Univ., Davis. Dept. of Civil Engineering.
E. Pasche, and G. Rouve.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 9, p 1262-1278, September 1985, 15 fig, 1 tab, 16 ref.

Descriptors: *Flood flow, *Channel flow, *Vegetation, *Flood plains, Compound channels, Turbulence, Flow characteristics, Model studies, Flood channels, Rivers.

An experimental and theoretical investigation into the flow characteristics of channels with complex cross sections was undertaken. Particular attention was given to the problem of non-submerged flood-plain roughnesses. This differs from previous studies in which compound-channel flow was primarily investigated for more or less uniform boundary roughnesses. In order to achieve more conformity with natural rivers, the flood plain and the main channel were separated in the model by a sloping bank. Two cross sections with varying aspect ratios and flood-plain roughnesses were investigated. The necessary measurements were carried out by applying Laser-Doppler-Velocimeter and Preston-tube techniques. On the basis of simple turbulence assumptions methods are presented by which the flow resistance in vegetatively roughened flood plains and main channels can be properly predicted as a function of independent and directly determinable basic flow parameters. A first verification of this model was accomplished using field measurements from an actual flood channel. (Authors' abstract)
W86-05966

SPILLAGE OVER AN INCLINED EMBANKMENT,

Norges Tekniske Hoegskole, Trondheim. Dept. of Physics and Mathematics.
H. I. Andersson.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 10, p 1299-1307, October 1985, 5 fig, 10 ref, append.

Descriptors: *Spillage, *Inclined embankment, *Storage tanks, Accidental release, Spill fraction, Dikes, Friction, Turbulence.

Accidental release of liquid from a storage tank, and the subsequent spillage over the surrounding embankment was investigated. The analysis is based on two simplifying assumptions: (1) The supercritical flow of the inclined embankment can be considered quasi-steady, and thus treated by a classical model for gradually varied flow in open-channels; (2) it is assumed that the overflow quenches when the level in the reservoir has reached a certain critical limit, so that the remaining liquid in the tank will be trapped by the dike. An analytical solution for the spill fraction is derived, showing that the spill fraction is a decreasing function of the ratio of the dike height to the initial tank level. The spill fraction is furthermore found to depend on a critical Froude number, which accounts for ground friction and turbulence, and a Chezy coefficient. The latter quantity, which accounts for ground friction and turbulence, is the only empirical parameter in the analysis. Predictions based on this simple model compare favorably with experimental observations from model inclines. (Author's abstract)
W86-05968

BED TOPOGRAPHY IN BENDS OF SAND-SILT RIVERS,

Saitama Univ. (Japan). Dept. of Foundation Engineering.
For primary bibliographic entry see Field 2J.
W86-05976

FORMATION OF ALTERNATE BARS,

San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W86-05977

HYDRODYNAMICALLY SMOOTH FLOWS OVER SURFACE MATERIAL IN ALLUVIAL CHANNELS,

Delaware Univ., Lewes. Coll. of Marine Studies.
J. Wu.
Journal of Hydraulic Engineering (ASCE) JHENDS8, Vol. 111, No. 11, p 1423-1427, November 1985, 1 fig, 1 tab, 19 ref. ONR Contract No. N00014-83-K-0316.

Descriptors: *Flow characteristics, *Bed load, *Alluvial channels, *Channel morphology, *Sediment transport Frictional resistance, Hydrodynamics, Surface material, Boundary layer regimes, Stream-bed materials, Roughness coefficient, Reynolds number.

It is a general practice to treat the flow in alluvial channels in two scales: the microscale over bed materials (sand grains), and the macroscale over bed forms. Contrary to common thinking, the flow over bed materials appears to be in the hydrodynamically smooth regime, or at most in the transition region. The boundary-layer regimes over grains is not hydrodynamically rough. This explains why the roughness-resistance coefficient of grains still varies with the Reynolds number. Such an identification is helpful in understanding flow and transport in alluvial channels. (McFarlane-PTT)
W86-05978

ANALYSIS AND SIMULATION OF LOW FLOW HYDRAULICS,

Tennessee Valley Authority, Norris. Water Systems Development Branch.
B. A. Miller, and H. G. Wenzel.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 12, p 1429-1446, December 1965, 5 fig, 4 tab, 18 ref.

Descriptors: *Alluvial channels, *Low flow, *Hydraulic properties, *Simulation, Flow characteristics, Mathematical models, Channel morphology, Flow resistance, Flow velocity, Riffles.

A one-dimensional mathematical model has been developed to simulate accurately channel characteristics under low flow conditions in alluvial channels. For a given steady discharge, channel geometry, and channel bed particle size distribution, the model predicts the flow depth, the mean velocity, and the flow resistance. Energy losses are assumed to result from flow resistance, as well as from local losses generated by the contractions and expansions occurring through the pool-riffle sequence. Laboratory and field data were used to calibrate and verify the model, as well as to conduct an in-depth analysis of the flow characteristics associated with low discharges. (Author's abstract)
W86-05979

RIVER FLOOD ROUTING BY NONLINEAR MUSKINGUM METHOD,

Wyoming Water Research Center, Laramie.
Y. Tung.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 12, p 1447-1460, December 1985, 6 fig, 2 tab, 36 ref.

Descriptors: *Rivers, *Floods, *Flood routing, Model studies, *Muskingum method, Storage, Discharge, Mathematical models, Flood discharge.

The linear form of the Muskingum model has been widely applied to river flood routing. However, a nonlinear relationship between storage and discharge exists in most actual river systems, making the use of the linear model inappropriate. In this report, a nonlinear Muskingum model is solved using the state variable modeling technique. Various curve fitting techniques were employed for the calibration of model parameters, and their performances within the model were compared. Both linear and nonlinear models were applied to an example with pronounced nonlinearity between storage and discharge. The results show that the nonlinear Muskingum model is superior to the linear one. (Author's abstract)
W86-05980

STEPPED SPILLWAY HYDRAULIC MODEL INVESTIGATION,

Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
R. M. Sorensen.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 12, p 1461-1472, December 1985, 8 fig, 2 tab, 9 ref.

Descriptors: *Spillways, *Hydraulic models, Energy dissipation, Flow characteristics, Structural models, Dams.

A physical hydraulic model was used to evaluate the performance of a stepped overflow spillway. The spillway has a standard ogee profile with continuous steps cut into the spillway face from just below the crest, to the toe. The steps significantly increase the rate of energy dissipation on the spillway face, thus eliminating or greatly reducing the need for a large energy dissipation basin at the spillway toe. Primary objectives of the investigation were to evaluate the effectiveness of the flow transition from the smooth crest profile to the steps, to quantify the energy dissipation on the spillway face, and to define the flow characteristics on the steps. The investigation demonstrated that this stepped spillway is quite effective at dissipating energy and that smooth flow transition from the spillway crest to the stepped face is easily achieved. (Author's abstract)
W86-05981

STABILITY OF DYNAMIC FLOOD ROUTING SCHEMES,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
J. Huang, and C. C. S. Song.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 12, p 1497-1505, December 1985. 9 fig, 1 tab, 8 ref. NSF Grant No. NSF/CEE 8025160.

Descriptors: *Flood routing, Diffusive explicit method, Channel flow, Koren's stability criterion.

The stability and accuracy of various numerical schemes related to the diffusive explicit method for one-dimensional unsteady open channel flow was studied by numerical analysis. The Koren stability criterion was found to be valid not only for the diffusive explicit method but also applicable to the characteristic method. This instability severely restricts the allowable grid size difference in time and channel distance when the Froude number is small. By treating the energy loss term in a semi-implicit manner without complicating the computational procedure, it is possible to improve significantly the stability of the numerical schemes. The most stable method is not necessarily the most accurate. (McFarlane-PTT)
W86-05983

ERRORS IN STORMWATER MODELING - A QUANTITATIVE ASSESSMENT,

National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2A.
W86-05985

TWO-DIMENSIONAL DAM-BREAK FLOOD-FLOW ANALYSIS FOR ORANGE COUNTY RESERVOIR,

Williamson and Schmid, Irvine, CA.
For primary bibliographic entry see Field 8A.
W86-06019

TWO-DIMENSIONAL DIFFUSION-PROBABILISTIC MODEL OF A SLOW DAM BREAK,

California Univ., Irvine. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8A.
W86-06020

ESTIMATING PEAK RUNOFF FROM FIELD-SIZE WATERSHEDS,

Agricultural Research Service, Columbia, MO.

North Central Watershed Research Unit.
A. T. Hjelmfelt, Jr.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 267-274, April 1986. 7 fig, 2 tab, 18 ref.

Descriptors: *Runoff models, *Agricultural watersheds, Iowa, *Kinematic wave equations, *Hydrographs, Measuring instruments, Error analysis, Seasons, Surface roughness, Overland flow, Hydrologic models, Topography, Weirs.

A simple nonlinear model was developed and tested (in western Iowa) for use on field-size agricultural watersheds. A Wooding idealization of the watershed topography was used. Kinematic wave equations were used with an assumed, instead of computed, overland flow, water surface profile in order to simplify the numerical computations. The approach was used to synthesize runoff hydrographs for an agricultural watershed in Iowa. The accuracy of the synthesized hydrographs was judged by comparing the estimated and observed peak discharges and by comparing estimated and observed stages at the measuring weir. The mean errors were 0.01 in/hr and 0.05 ft, respectively. A qualitative comparison was also made with a detailed kinematic wave study. The largest variability occurred during the seedbed period for both models, which was attributed to changes in surface roughness. Roughness was more constant and the results more consistent for canopy and ground residue periods. (Author's abstract)
W86-06021

GRAVITY PRESSURE COLLECTION SYSTEM DRAINS VIADUCT,
Howard, Needles, Tammen, and Bergendoff, Kansas City, MO.
For primary bibliographic entry see Field 8A.
W86-06044

APPLICATION OF BOUNDARY INTEGRAL EQUATION METHOD FOR MODELLING UNSTEADY NONLINEAR WATER WAVES,
Alexandria Univ. (Egypt). Faculty of Engineering.
Y. Z. Boutros, M. N. Anwar, and A. H. Tewfick.
Applied Mathematical Modelling AMMODL, Vol. 10, No. 1, p 11-15, February 1986. 5 fig, 23 ref.

Descriptors: *Mathematical models, *Waves, Deep water, Wave velocity.

A method was developed for the numerical study of deformation of steep surface waves propagating in water of infinite depth. The approach was to trace the time evolution of the free surface after solving an integral equation for the normal component of the velocity potential. Such a solution depends on lengthy computations involving Lagrangian interpolating polynomials. The present work modifies this approach by adopting the boundary integral equation method for the determination of the normal component of velocity. Numerical experiments are presented for different initial wave profiles, and results are compared for the two methods. (Author's abstract)
W86-06066

UNIFIED BAR-BEND THEORY OF RIVER MEANDERS,
Genoa Univ. (Italy). Inst. of Hydraulics.
P. Blondeaux, and G. Seminara.
Journal of Fluid Mechanics JFLSA7, Vol. 157, p 449-470, August 1985. 8 fig. 35 ref. GNR Grant No. 83.00155.07.

Descriptors: *Hydrologic models, *Meanders, *Rivers, *Theoretical analysis, *River beds, River flow, Topography, Hydrologic models, Channel flow, Flow pattern, Bank erosion, Channel erosion, Resonance.

A two-dimensional model of flow and bed topography in sinuous channels with erodible boundaries was developed and applied in order to investigate the mechanism of meander initiation. By reexamining the problem, a previously undiscovered 'resonance' phenomenon was detected which occured when the values of the relevant parameters fell within a neighborhood of certain critical values. It was suggested that the above resonance controls bend growth, and it is shown that it is connected in some sense with bar instability. In fact, by performing a linear stability analysis of flow in straight erodible channels, resonant flow in sinuous channels is shown to occur when curvature 'forces' a 'natural' solution, represented by approximately steady perturbations of the alternate bar type. A comparison with experimental observations appears to support the idea that resonance is associated with meander formation. (Author's abstract)
W86-06144

AXISYMMETRIC WITHDRAWAL AND INFLOW IN A DENSITY-STRATIFIED CONTAINER,
Australian National Univ., Canberra. Research School of Earth Sciences.
For primary bibliographic entry see Field 5G.
W86-06145

SPRING CHARACTERISTICS AND HYDROLOGICAL MODELS OF CATCHMENTS, A CASE STUDY FROM ASTDALEN, S.E. NORWAY,
Norges Landbrukshoegskole, Aas. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W86-06163

COMBINATION OF SIMULATED DISCHARGES OF HYDROLOGICAL MODELS. APPLICATION OF THE WMO INTERCOMPARISON OF CONCEPTUAL MODELS OF SNOWMELT RUNOFF,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
G. Cavadias, and G. Morin.
Nordic Hydrology, Vol. 17, No. 1, p 21-30, 1986. 2 fig, 5 tab, 8 ref.

Descriptors: *Simulation analysis, *Hydrologic models, *Snowmelt, *Runoff, Streamflow, Mathematical analysis, Discharge measurement, Streamflow forecasting.

Hydrologic models are frequently used to simulate streamflow. One method for improving performance, is to combine the simulated discharges of two or more models. Three different methods are given in detail for the calculation of the weights used in this combination. Various methods are applied to the combination of simulated discharges of conceptual deterministic models, which participated in the recent World Meteorological Organization (WMO) intercomparison of snowmelt runoff WMO models. The numerical criteria adopted in this study were used to evaluate the performance of the combined simulated discharges. Approximately 80% of the combinations of two simulated discharges result in better criteria values than the component individual discharges for the complete year. The corresponding percentage for the snowmelt season is 70%. The reduced percentage for the snowmelt season may be due to the fact that the combination of discharges for the season is based on weights optimized for the complete year, and not specifically for the snowmelt season. The mean improvements in the criterion values are substantially larger than the losses in criterion values in cases where the combination does not result in an improvement. Due to the large number of possibilities of combining three models, overall percentages such as the above, were not computed for this case. However, the combination of three simulated discharges represents a slight improvement over the combination of two simulated discharges. An additional result of the combination of simulated discharges is that the range of annual criterion values is reduced for the calibration and verification period. This is desirable because the corresponding reduced confidence intervals result in a more consistent computation. (Lantz-PTT)
W86-06164

GEOCHEMICAL INVESTIGATIONS OF THREE TROPICAL KARST DRAINAGE BASINS IN PUERTO RICO,
Pennsylvania State Univ., University Park. Dept. of Geosciences.
J. W. Troester, and W. B. White.
Ground Water GRWAAP, Vol. 24, No. 4, p 475-482, July-August 1986. 7 fig, 3 tab, 22 ref.

Descriptors: *Geochemistry, *Karst, *Catchment basins, *Puerto Rico, Carbonates, Carbon dioxide, Spring water, Temperate zone, Rio Camuy, Rio Grande de Arecibo, Rio Tanama.

The carbonate chemistry was measured at various springs and surface stations along three river basins in the northwestern karst belt of Puerto Rico (the Rio Grande de Arecibo, the Rio Tanama, and the Rio Camuy). Most surface waters are supersaturated with respect to calcite, and carbon dioxide pressures are close to atmospheric value. Spring waters have higher carbon dioxide pressures, but also tend to be supersaturated. Water hardnesses are not dramatically greater than those observed in temperate climate karst. From the limited amount of data collected in this reconnaissance study, the following conclusions can be tentatively advanced: 1) most surface streams in the North Puerto Rico karst are supersaturated with respect to calcite, probably because of rapid degassing of carbon dioxide. Unlike temperate climate karst, spring waters are near saturation; 2) carbonate hardness in surface streams is comparable to hardnesses found in temperate climate karst; and 3) consistent with the observed hardnesses, the carbon dioxide partial pressures are also comparable to those in temperate climate karst, although one spring has higher carbon dioxide levels. There was little season variation in carbon dioxide pressure for the Camuy River resurgence. (Lantz-PTT)
W86-06171

2F. Groundwater

SOLUTIONS FOR RADIONUCLIDE TRANSPORT FROM AN INJECTION WELL INTO A SINGLE FRACTURE IN A POROUS FORMATION,
Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W86-05431

GROUNDWATER TRANSPORT OF STRONTIUM 90 IN A GLACIAL OUTWASH ENVIRONMENT,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W86-05432

RADIONUCLIDE MIGRATION IN STRONGLY FISSURED ZONES: THE SENSITIVITY TO SOME ASSUMPTIONS AND PARAMETERS,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W86-05436

DIFFUSIVITY MEASUREMENTS AND ELECTRICAL RESISTIVITY MEASUREMENTS IN ROCK SAMPLES UNDER MECHANICAL STRESS,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W86-05437

REGRESSION APPROXIMATIONS FOR TRANSPORT MODEL CONSTRAINT SETS IN COMBINED AQUIFER SIMULATION-OPTIMIZATION STUDIES,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W86-05438

RATIO, TRANSMISSIVITY/STORATIVITY FROM ELECTRIC ANALOG VALUES OF STREAMFLOW,
James Madison Univ., Harrisonburg, VA. Dept. of

Geology and Geography.
For primary bibliographic entry see Field 2E.
W86-05440

SUSTAINED-YIELD GROUND-WATER PLANNING BY GOAL PROGRAMMING,

Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
A. Yazdanian, and R. C. Peralta.
Ground Water GRWAAP, Vol. 24, No. 2, p 157-165, March-April, 1986. 6 fig, 1 tab, 18 ref.

Descriptors: *Groundwater management, *Water level fluctuations, Model studies, Aquifers, Recharge, Groundwater recharge.

A method for determining a spatially distributed set of groundwater withdrawals that maintains a regionally optimized potentiometric surface is presented. A goal-programming approach, in its quadratic form, is used to minimize the sum of squares of differences between the optimized surface and a target potentiometric surface. Constraints on withdrawals and recharge, imposed through a two-dimensional groundwater flow equation, and bounds on drawdowns assure that the withdrawal strategy developed is realistic and physically feasible. Application is demonstrated using data from the Grand Prairie region of Arkansas. Through dynamic monthly simulation using a validated ground-water model, it is shown that the annual pumping strategy associated with the optimal ground water elevations, does maintain those elevation. (Cassar-PTT)
W86-05441

PREDICTIVE ACCURACY OF A GROUND-WATER MODEL--LESSONS FROM A POSTAUDIT,

Geological Survey, Reston, VA.
L. F. Konikow.
Ground Water GRWAAP, Vol. 24, No. 2, p 173-184, March-April, 1986. 12 fig, 8 ref.

Descriptors: *Model studies, *Water yield, *Groundwater, *Geohydrology, Salt River, Santa Cruz River, Arizona, Wells, Water level fluctuations, Pumping, Water table, Aquifers.

A postaudit was conducted on a previously studied area in the Salt River and lower Santa Cruz River basins, Arizona, to help assess the value of using a deterministic simulation model in making predictions of groundwater levels in wells. A deterministic, distributed-parameter model of the groundwater system in these basins, calibrated using 40 yr of data (1923-1964) was used to predict future water level changes during the next 10 yr (1965-1974). Comparison with the actual levels in 77 wells showed poor correlation between observed and predicted water level changes. The differences had a mean of -73 ft (predicted declines consistently exceed those observed) and a standard deviation of 47 ft. The bias was attributed to a large error in assumed total pumpage during the prediction period. Other errors were also suspected, such as the two-dimensional representation of a three-dimensional problem or the lack of consideration of land substance. (Cassar-PTT)
W86-05443

HYDROGEOLOGY OF AN ATOLL ISLAND: A CONCEPTUAL MODEL FROM DETAILED STUDY OF A MICRONESIAN EXAMPLE,

Nebraska Univ., Lincoln. Conservation and Survey Div.
J. F. Ayers, and H. L. Vacher.
Ground Water GRWAAP, Vol. 24, No. 2, p 185-198, March-April, 1986. 10 fig, 3 tab, 17 ref.

Descriptors: *Groundwater, *Atolls, Lagoons, *Geohydrology, Deke Island, Caroline Islands, Unconfined aquifers, Model studies, Confined aquifers, Aquifers, Islands, Reefs, Lenses, Sediments.

A conceptual model is proposed to describe the relationship between the occurrence and flow of groundwater in atoll islands are related to the underlying geologic framework. The study island is Deke, an uninhabited island on Pingelap Atoll, Eastern Caroline Islands. The island straddles the lagoonward edge of the very firmly indurated reef-flat plate. This plate is a hard, impermeable substrate lying at sea level and underlain by unconsolidated or loosely cemented sediments. Thus the fresh water lens is confined along the ocean side. The model involves a dual aquifer system: (1) an aquifer of mostly unconsolidated Holocene sediments resting on (2) a once-emergent and now very permeable Pleistocene limestone platform. In the unconfined region exists a central depression, a probable groundwater sink. The model includes two flow patterns: a wet season pattern radiating outward from the unconfined lagoon side of the island and a dry season pattern that includes a superimposed area of centripetal flow at the central depression. (Cassar-PTT)
W86-05444

COMPARATIVE STUDY OF GROUND-WATER MAPPING TECHNIQUES,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 7B.
W86-05446

DETERMINATION OF AQUIFER PARAMETERS BY THE SLOPE-MATCHING METHOD,

King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Earth Sciences.
Z. Sen.
Ground Water GWAAP, Vol. 24, No. 2, p 217-223, March-April, 1986. 6 tab, 14 ref.

Descriptors: *Groundwater, *Slope analysis, *Aquifer characteristics, Transmissivity, Storage coefficient, Nonleaky aquifers, Leaky aquifers, Model studies, Pumping tests, Drawdown.

A method has been developed by which the slope between any two successive data points on a time-drawdown plot can be used for determining aquifer parameters in nonleaky and leaky aquifers. The method, known as the slope-matching method (SM), yields values of transmissivity and storage coefficient which are good in agreement with the results of the classically known techniques. The SM can be applied to any aquifer provided that the slopes of the appropriate type curve are known. The method of slope analysis offers several advantages in its use. These advantages include the following: Changes in values for the aquifer parameters that might occur during a pumping test can be identified. Confidence limits can be calculated for average values of aquifer parameters. The method yields meaningful aquifer parameter estimates even for short duration pumping tests. Subjective interpretation of the data is minimized. A hand calculator is adequate for all the calculations involved. (Cassar-PTT)
W86-05447

ANALYTICAL MODELING OF GROUND-WATER IMPACTS BY MINING,

Koch and Associates, Denver, CO.
For primary bibliographic entry see Field 4C.
W86-05448

OCCURRENCE OF VOLATILE ORGANIC CHEMICALS IN NEBRASKA GROUND WATER,

Hoskins-Western-Sonderegger, Inc., Lincoln, NE.
For primary bibliographic entry see Field 5B.
W86-05449

BASIC ENCODED MODEL FOR FLOW-THROUGH FIXED-BED ADSORBER AND ONE-DIMENSIONAL GROUND WATER SYSTEMS,

New Jersey Agricultural Experiment Station, New Brunswick.
For primary bibliographic entry see Field 5B.
W86-05465

ROLE OF VOLCANIC TUFFS IN GROUND-WATER REGIME OF VALLE CENTRAL, COSTA RICA,

British Geological Survey, Wallingford (England).
S. S. D. Foster, A. T. Ellis, M. Losilla-Penon, and H. V. Rodriquez-Estrada.
Ground Water GRWAAP, Vol. 23, No. 6, p 795-801, November-December 1985. 5 fig, 8 ref.

Descriptors: *Geohydrology, *Volcanic tuffs, Groundwater movement, *Valle Central, *Costa Rica, Rock properties, Transmissivity, Porosity, Hydraulic conductivity, Aquifers, Lava, Measuring instruments, Flow velocities.

Most ground-water supplies in the Valle Central are derived from a number of major lava formations, which can possess high transmissivity with exceptionally steep hydraulic gradients, implying very high groundwater flow velocities, despite apparently limited groundwater storage. Laboratory and field testing programs on the hydraulic properties of volcanic rocks were undertaken. Sixty-five samples for laboratory testing were selected from available cores of six boreholes, to be broadly representative of the volcanic strata present in the Valle Central, but concentrating especially on tuffaceous deposits. The rock plugs were tested in a standard gas permeameter with nitrogen as the test fluid. Most of the tuffaceous deposits were shown to have exceptionally high effective porosity (45-65%), moderate hydraulic conductivity (0.02-0.5 m/d) and very broad pore-size distributions. Rather unexpectedly, they provide the major element of regulating storage in the overall groundwater regime. The results presented suggest that more detailed study of the hydraulic properties of some pyroclastic sequences, interbedded with lava aquifers, could be a profitable line of research in view of their important hydrogeological role. (Main-PTT)
W86-05531

AUTOMATED DERIVATION OF PARAMETERS IN A NONLEAKY CONFINED AQUIFER WITH TRANSIENT FLOW,

Kuwait Inst. for Scientific Research, Safat.
A. Mukhopadhyay.
Ground Water GRWAAP, Vol. 23, No. 6, p 806-811, November-December 1985. 2 tab, 8 ref, 3 append.

Descriptors: *Confined aquifers, *Transient flow, *Groundwater movement, Computer Programs, Transmissivity, Well function, Statistical analysis, Graphical analysis, Mathematical analysis, Automation, Goodness of fit.

Values of transmissivity and storage commonly are derived for a nonleaky confined aquifer by manual curve matching of pumping-test data. Automatic matching of pumping-test data with the Theis type curve is possible using the method of least squares, provided the Cooper-Jacob approximation of the well function W(u) is considered. A FORTRAN program was developed to carry out this automated matching. Results derived from published data show that the method gives parameters close to the ones derived by the standard method of manual curve matching. The method gives unbiased estimates of transmissivity and drawdown as long as the parameter u is less than 0.05. The program can eliminate data points that do not give a good fit. (Main-PTT)
W86-05532

ANGULARITY OF AGGREGATE PARTICLES AS A MEASURE OF THEIR SHAPE AND HYDRAULIC RESISTANCE,

Aligarh Muslim Univ. (India).
For primary bibliographic entry see Field 8G.
W86-05596

SNOWMELT AND GROUNDWATER STORAGE IN AN ALPINE BASIN,

Eidgenoessisches Inst. fuer Schnee- und Lawinenforschung, Davos (Switzerland).
J. Martinec, H. Oeschger, U. Schotterer, and U. Siegenthaler.

IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982, Exeter, England. p 169-175, 6 fig, 8 ref.

Descriptors: *Snowmelt, *Groundwater, *Hydrology, *Tritium, Ice, Snow, Water management, Water measurement, Runoff, Runoff hydrographs, Snow accumulation, Snow surveys, Alpine regions, Mountains, Radioactive tracers.

In contrast to usual runoff concepts emphasizing the role of surface flow, tracer studies using environmental isotopes reveal a large groundwater recharge from snowmelt, and a similarly large amount of groundwater in the discharge from the Alpine basin Dischma. Concentrations of tritium indicate an average residence time of groundwater of four to five years. Thus the groundwater storage capacity appears to exceed the conventional estimates for mountain basins significantly. A quick effect of meltwater infiltration on the outflow from groundwater reserves, caused by rapid pressure transmission, has to be assumed. Such an effect was actually demonstrated by others in a laboratory model. This runoff mechanism seems to be confirmed in various other basins by other authors. (See also W86-05610) (Author's abstract)
W86-05629

IMPROVEMENT OF METHODS OF LONG TERM PREDICTION OF VARIATIONS IN GROUNDWATER RESOURCES AND REGIMES DUE TO HUMAN ACTIVITY.

Institute of Hydrology, Wallingford (England).
Available from IAHS, 2000 Florida Ave., NW, Washington, DC 20009, Price: $30.00 as IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. Edited by G. P. Jones. 343 p.

Descriptors: *Groundwater management, *Water resources development, *Groundwater mining. *Future planning, *Groundwater recharge, Prediction, Management planning, Aquifers, Land use, Hydrologic models, Mathematical models, Regional analysis, Regional development, Ecological effects, Environmental effects, Environmental impact statement.

Modifications to the sub-surface components of the water cycle due to human activity are less obvious than surface phenomena and therefore frequently receive less attention. The extent and severity of changes to the natural groundwater regime provide the impetus for the introduction of proper groundwater management within adequate legislation and institutional framework. Variations in groundwater resources and regimes that are taking place on a wide range of scales throughout the world may be felt for centuries to come. Greater use must be made of forecasting techniques that allow prediction of long-term effects in order that control measures can be introduced in sufficient time. Papers presented in this book address these problems under four different headings: methods of prediction of groundwater resources; measurement and sensitivity analysis of parameters governing groundwater resources; and regional studies on variations of groundwater resources and regimes. These papers were chosen to encourage useful discussion at future symposiums, as well as stimulate a wider range of workers to apply such methodology to their particular hydrogeological conditions. (See also W86-05646 thru W86-05678) (Geiger - PTT)
W86-05645

METHODOLOGY OF REGIONAL HYDROGEOLOGICAL FORECASTS FOR INTERBASIN WATER TRANSFER OPERATION,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 4B.
W86-05646

METHODS USED IN THE PREDICTION AND CONTROL OF THE GROUNDWATER REGIME IN BASINS ADJACENT TO LARGE RIVERS,

J. Benetin, V. Halek, and I. Radcenko.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 9-23, 8 fig, 11 ref.

Descriptors: *Groundwater basins, *Mathematical models, *Prediction, *Water resources development, *Mathematical studies, Water pollution prevention, Rivers, Groundwater movement, Mathematical equations, Groundwater management, Hydraulic structures, Danube River, Rye Island, Bratislava.

The paper reviews methods successfully used in study of the groundwater regime and the elaboration of long-term predictions in connection with the projects involving hydraulic structures. The determination of natural and man-affected hydrological processes influencing the groundwater regime is included with regard to the regulation, exploitation and protection of groundwater resources. On the basis of the differential flow equations the suitability of various methods of physical and mathematical modelling for solving of groundwater problems is evaluated. The application of these methods is shown in an example of a groundwater basin adjacent to the River Danube on the territory of Rye Island near Bratislava. Even in the past, human activity has considerably interfered in the groundwater regime of the study area, and the interference still grows by the realization of the new Danube projects. The effect of the so-called hydraulic barrier, used for the protection of groundwater against the industrial waste pollution, is also shown. (See also W86-05610) (Author's abstract)
W86-05647

PREDICTION OF UNDERGROUND WATER REGIME AND BALANCE IN LANDS UNDER RECLAMATION,

For primary bibliographic entry see Field 4C.
W86-05648

ARTIFICIAL GROUNDWATER RECHARGE IN QUATERNARY GRAVEL AQUIFERS IN THE FORELAND OF THE ALPS,

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
For primary bibliographic entry see Field 4B.
W86-05649

LONG-RANGE PREDICTION OF GROUNDWATER LEVELS IN A VOLCANIC UPLAND USING AN AQUIFER MODEL WITH SOIL WATER SUBSYSTEM,

Tsukuba Univ. (Japan). Inst. of Geoscience.
I. Kayane, and J. Koyama.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 43-51, 6 fig, 2 tab.

Descriptors: *Groundwater level, *Prediction, *Model studies, *Simulation analysis, *Aquifers, Soil water, Groundwater storage, Hydrologic budget, Hydrologic models, Groundwater recharge, Infiltration, Groundwater movement, Groundwater basins, Water table, Geohydrology, Aso caldera, Kumamoto upland, Japan.

Long-range simulation of groundwater levels in the Kumamoto upland composed of pyroclastic flow deposits from the Aso caldera is made using a water balance model consisting of tank models for soil water and a two-dimensional horizontal aquifer model for groundwater. Though geologically complicated, scarce data is available for aquifer constants in the study area. Tank models are used to identify the value of storativity as well as to give the time delay between infiltration and groundwater response. The value of transmissivity is determined by the method of trial and error. The model shows fairly good degree of fitness after 20 years computation run. The water balance model is found to be useful in the diagnosis of aquifer characteristics. (See also W86-05645) (Author's abstract)
W86-05650

PROBLEMS OF LONG-TERM GROUNDWATER REGIME AND RESOURCES FORECASTING,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. S. Kovalevsky.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 53-60, 5 fig, 4 ref.

Descriptors: *Geohydrology, *Forecasting, *Long-term planning, *Water resources development, *Statistical analysis, Markov process, Mathematical studies, Statistical methods, Prediction, Groundwater level, Groundwater movement.

In many cases, long-term (i.e., more than one year) forecasts of the groundwater regime are composed of separate forecasts of natural and disturbed groundwater regimes. It is especially difficult to make forecasts of the natural groundwater regime. The solution of this problem is possible in different ways: on the basis of identifying and forecasting exposed long-term trends, i.e., by trend analysis of long series of observations; on the basis of statistical analysis of possible duration series of dry and water-abundant years for a given probability; on the basis of forecasting possible fluctuations in groundwater levels and discharges as a random Markov process; and on the basis of consideration of inertial properties of aquifers. (See also W86-05645) (Author's abstract)
W86-05651

METHOD OF DEFINING THE EXPLOITABLE RESOURCE OF A LARGE DEEP CONFINED AQUIFER UNDER THE CONDITION OF ANNUAL EQUILIBRIUM,

Hebei Province Geology Bureau, Shijiazhuang (China). Hydrogeological Station.
L. Xuezeng.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 61-70, 4 fig.

Descriptors: *Confined aquifers, *Groundwater potential, *Mathematical equations, *Water resources development, *Mathematical studies, Groundwater level, Groundwater recharge, Water pressure, Groundwater management, Groundwater mining, Geohydrology, Regional development, Semiarid lands, Aquifers, Water demand, Hebei Plain, China.

Exploitation of a deep confined aquifer has developed rapidly in part of the semiarid Hebei Plain of China to meet water demands from industry and agriculture, that amounted to 1500 million cu m in 1979. The intense use has produced a fall in the groundwater head of over 20 m which has resulted in a loss of overflowing conditions over much of the study area. For the optimum development of the confined aquifer, it is necessary to determine the regionally exploitable resources. A regional water equilibrium equation is derived for use in the method of regional water averaged to determine the exploitable resources. The exploitable resource is calculated and defined for the Heilonggang District of the Hebei Plain. An example of the method and process of defining the regional exploitable resource of the deep pressure aquifer under the condition of annual equilibrium is given for the

east plain of Xingtai in the Heilonggang District. (See also W86-05645) (Geiger - PTT)
W86-05652

SOME HYDROGEOLOGICAL PROBLEMS RELATED TO URBAN WATER SUPPLY DEVELOPMENT IN CHINA,

Ministry of Geology and Minerals, Beijing (China). Bureau of Hydrogeology and Engineering Geology.
For primary bibliographic entry see Field 4B.
W86-05653

VARIATION OF THE GROUNDWATER REGIME UNDER THE EFFECTS OF HUMAN ACTIVITIES AND ITS ARTIFICIAL CONTROL,

Ministry of Geology and Minerals, Beijing (China). Bureau of Hydrogeology and Engineering Geology.
For primary bibliographic entry see Field 4C.
W86-05654

EFFECTS OF LAND-USE CHANGES ON GROUNDWATER RECHARGE ASSESSED USING A NONLINEAR CATCHMENT MODEL,

Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4C.
W86-05655

CHANGE OF RUNOFF CHARACTERISTICS BY URBANIZATION,

National Research Center for Disaster Prevention, Sakura (Japan).
For primary bibliographic entry see Field 4A.
W86-05656

SYSTEMATIC DECLINE OF GROUNDWATER LEVEL IN THE REGOLITHS OF THE NIGERIAN BASEMENT COMPLEX DUE TO HUMAN ACTIVITIES,

Ife Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 4C.
W86-05657

NEW POSSIBILITIES AND METHODS OF IN SITU GROUNDWATER TREATMENT IN GRAVEL SAND AQUIFERS,

For primary bibliographic entry see Field 5G.
W86-05658

PROBLEMS OF GROUNDWATER RESOURCE MANAGEMENT IN A DEVELOPED BASIN,

Severn-Trent Water Authority (England).
For primary bibliographic entry see Field 4B.
W86-05659

ASSESSMENT OF THE EFFECTS OF LAND USE ON GROUNDWATER RECHARGE,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4C.
W86-05660

DYNAMIC FEATURES OF CONES OF INFLUENCE OF DEEP GROUNDWATER IN THE HEILONGGANG DISTRICT OF HEBEI PLAIN,

Hebei Province Geology Bureau, Shijiazhuang (China). Hydrogeological Station.
For primary bibliographic entry see Field 4B.
W86-05661

RAINFALL-RECHARGE CORRELATION; A METHOD FOR EVALUATING POTENTIAL GROUNDWATER,

State Water Investigation Directorate, Calcutta (India).
B. K. Bhattacharjee.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 161-167, 1 fig, 3 tab, 5 ref.

Descriptors: *Groundwater recharge, *Natural recharge, *Mathematical equations, *Aquifers, *Groundwater potential, Groundwater level, Rainfall, Observation wells, Geohydrology, Rainfall-runoff relationships, Regression analysis, Groundwater level, Bengal, Hydrographs.

The macro-level water balance and its correlation with rainfall can be used to calculate groundwater recharge to an unconfined aquifer. The hydrographs of 15 observation wells in the Hooghly district of West Bengal, for the years 1978 to 1980, were analyzed. A good correlation was found between seasonal rainfall and changes in water level. By evaluating the increment in groundwater reserve, and checking the specific yield of the aquifer by pumping tests, the potential groundwater for the area was estimated to be on the order of 2360 million cu m. The safe limit of extraction was calculated to be on the order of 1570 million cu m, keeping one third in reserve for drought situations. (See also W86-05645) (Geiger - PTT)
W86-05662

MECHANISM OF VERTICAL WATER MOVEMENT IN KANTO LOAM DURING AND AFTER RAINFALL,

Tsukuba Univ. (Japan). Inst. of Geoscience.
For primary bibliographic entry see Field 2G.
W86-05663

NONLINEAR OPTIMIZATION FOR AQUIFER PARAMETER ESTIMATION WITH INADEQUATE DATA,

Roorkee Univ. (India). School of Hydrology.
D. Kashyap, and S. Chandra.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 179-185, 1 tab, 7 ref.

Descriptors: *Mathematical models, *Groundwater recharge, *Rainfall-runoff relationships, *Groundwater mining, *Natural recharge, Groundwater level, Mathematical studies, Mathematical equations, *Aquifers, *Nonlinear optimization, Spatial distribution, Geohydrology, Statistical analysis, India, Boussinesq's equation.

A numerical scheme has been developed to estimate the parameters relating to the geohydrologic and hydrologic characteristics of groundwater aquifers, employing the historical data of water-table elevations, rainfall, and groundwater withdrawals. The scheme, falling in the category of direct methods of the inverse problem, is based upon the constrained minimization of the sum of the squares of the residues of Boussinesq's equation. Derivatives of the piezometric head are estimated by least squares polynomial approximation. The scheme, apart from the estimation of aquifer properties, also affords calibration of the prevailing rainfall-recharge equations. The use of the scheme has been illustrated by employing the historical data of the Krishni-Hindon basin in India. The aquifer characteristics, including the orientation of the directions of principal permeability and the parameters of a linear rainfall-recharge relationship, have been evaluated for fifteen space points. (See also W86-05645) (Author's Abstract)
W86-05664

LONG-RANGE GROUNDWATER LEVEL PREDICTION BASED ON TIME SERIES ANALYSIS,

Budapesti Mueszaki Egyetem (Hungary). Inst. of Water Management.
I. Kontur.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 187-193, 5 fig, 2 ref.

Descriptors: *Groundwater level, *Prediction, *Time series analysis, *Mathematical studies, Models, Model studies, Mathematical models, Geohydrology, Observation wells, Hungary.

A 40-year long record is available for some 40 observation wells for groundwater level variations in the Hungarian lowlands. Time series analysis of the record affords the possibility of developing forecasting models for long-range groundwater level prediction. Prediction by time series analysis follows identification of four interrelated components (trend, periodicity, asymmetry and regularity) which makes difficult the unambiguous forecasting of areas which are complicated by human activities. The final time series pattern that was identified reveals clearly that no single periodic component is suited to describing the time series even approximately well. Neither can it be decided whether the same time series patterns are typical of other areas of the world. (See also W86-05645) (Geiger - PTT)
W86-05665

EVALUATION OF PUMPING TESTS; IDENTIFICATION OF PARAMETER VALUES AND THEIR RELIABILITY,

Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
For primary bibliographic entry see Field 4B.
W86-05666

ANALYSIS OF PERENNIAL FLUCTUATIONS OF THE GROUNDWATER TABLE IN PART OF THE ALLUVIO-PROLUVIAL FAN OF YONGDING RIVER, CHINA,

Beijing Municipal Hydrogeological and Engineering Geological Corp. (China).
H. Mingmin.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 205-212, 2 fig, 1 tab.

Descriptors: *Groundwater level, *Water table fluctuations, *Graphical methods, *Water level fluctuations, *Groundwater mining, *Yongding River, *China, Groundwater depletion, Mathematical studies, Graphical analysis, Time series analysis, Stochastic process, Prediction, Statistical analysis.

Observations were made of the perennial fluctuations of the water table, taking them as a time sequence of stochastic nature. By a graphic method with translation of coordinates, both the tendency component of the perennial stability before overpumping, and that of the perennial continuous decrease after overpumping of groundwater in the apical part of the alluvio-proluvial fan of the Yongding River, are obtained in one operation. The superposition of a limited number of sinusoidal waves is also made use of to fit the fluctuation of the annual mean water table along its trend component. Then the major period of the fluctuation and its corresponding periodic function are determined by the amplitude of the waves and Fisher's criterion. (See also W86-05645) (Author's abstract)
W86-05667

AQUIFER DEMANDS MET FROM STORAGE OR RECHARGE,

Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 213-224, 7 fig, 1 tab, 10 ref.

Descriptors: *Hydrologic budget, *Aquifers, *Groundwater storage, *Groundwater recharge, *Mathematical models, Numerical analysis, Pump wells, Natural recharge, Mathematical studies, Model studies, Geohydrology, England, Field tests.

Four aquifer studies in the United Kingdom are described to show how aquifer demands can be supplied either from storage or from recharge. In each of the examples the balance between the various sources of water could only be identified by the combination of a field study and a mathematical model. A detailed description is given of a Chalk aquifer in which major features include the limited ability of the aquifer to transmit potential recharge and the importance of local dewatering around pumped wells. Using a numerical model to simulate aquifer conditions, a number of important features in the assessment of long term water balances were discovered. These include the need to study a sufficiently long time period, a realistic assessment of the recharge mechanism, the effect of low transmissivities in restricting the flow of groundwater, the contribution to water released from storage of strata which would often be classed as aquitards, the need to consider the aquifer system of all the strata rather than concentrating on the main rock type, the accurate representation of local dewatering and the manner in which saline inflow can release fresh water from abstraction. (See also W86-05645) (Geiger - PTT)
W86-05668

MULTIVARIATE STOCHASTIC MODEL FOR THE RECONSTRUCTION OF GROUNDWATER DATA,
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
W. Schilling, and T. Einfalt.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 225-232, 5 fig, 2 ref.

Descriptors: *Groundwater level, *Mathematical models, *Stochastic process, *Hydrologic models, *Mathematical studies, Mathematical equations, Statistical methods, Models, Model studies, Rainfall, Hydrologic budget.

In practice, groundwater data, unlike hydrologic variables such as rainfall or runoff, exist for quite short periods. Since groundwater levels are linked to these variables via the hydrologic cycle a dynamic regression procedure for the reconstruction of groundwater level data is considered. A linear model describing the dynamic changes of groundwater levels due to internal persistence, external hydrological variables, artificial withdrawal and stochastic disturbances is proposed. Model parameters are identified by a combined correlation and least squares estimation procedure. Starting with the last known groundwater data, reconstructions for subsequent time steps are obtained by using other (known) hydrological data. Reliability can be tested by re-modelling the already observed groundwater data sequences, while reconstruction of groundwater levels into the past can be obtained by inversion of the model. Stability of any model is crucial for its long-term performance and adjustments to obtain a stable system are proposed. The lengths of groundwater data series used in the numerical example are about 5 years. Observations of other hydrological variables exist for another 7 years. A simple example for two observation wells and one external variable is presented. (See also W86-05645) (Author's abstract)
W86-05669

GROUNDWATER SIMULATION MODEL FOR A SHALLOW WATER TABLE AQUIFER,
Haryana Agricultural Univ., Hissar (India). Centre of Soil and Water Management.
For primary bibliographic entry see Field 4B.
W86-05670

EQUATION BASED THEORETICAL APPROACH TO NETWORK DESIGN FOR GROUNDWATER LEVELS USING KALMAN FILTERS,
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
F. C. Van Geer.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 241-250, 6 fig, 1 tab, 6 ref.

Descriptors: *Groundwater level, *Theoretical analysis, *Network design, *Mathematical models, *Kalman filters, Mathematical studies, Mathematical equations, Groundwater movement, Observation wells, Netherlands.

In the Netherlands there exists a dense network for measuring groundwater levels. Between the observation wells the groundwater level is interpolated in order to have data for use in groundwater flow models. In this study the confidence interval of the interpolations is considered. The method which is used is the Kalman filter, which is applied to a strongly simplified case with one-dimensional phreatic groundwater flow. With the results presented in the paper, it is possible to design an optimal measuring network for such a case. (See also W86-05645) (Author's abstract)
W86-05671

MATHEMATICAL MODEL OF COMPLEX, LEAKY, MULTI-AQUIFER SYSTEMS AND ITS SOLUTION,
Zhengding Inst. of Hydrogeology and Engineering Geology (China).
W. Zhaocong.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982.

Descriptors: *Groundwater movement, *Leaky aquifers, *Aquifers systems, *Mathematical models, *Geohydrology, Mathematical studies, Infiltration, Finite element method, Mathematical equations, Drawdown, Seepage, Groundwater recharge, Aquifers, China.

The theory of leaky multi-aquifer systems has reached the stage at which realistic complex systems have to replace the traditional ideal leaky aquifer concepts. In this paper, the nature of such complex systems is considered and a theoretical derivation is made of the corresponding mathematical model and its solution by the finite-element method. An attempt is made to introduce the third type of boundary condition as well as the complications of river bed seepage. The exact mathematical expressions are used to give the final system of equations for the drawdown field. The model was used to test a solution for the prediction of mine inflow in a mining area in China possessing a quaternary aquifer system. Using the final system of equations for drawdown field, predictive calculations of the inflow to be dewatered have been made and the relatively reasonable volume to be dewatered obtained with prediction of the behavior of dewatering of the whole system. (See also W86-05645) (Geiger - PTT)
W86-05672

PROBLEMS OF GROUNDWATER DEVELOPMENT IN THE SANA'A BASIN, YEMEN ARAB REPUBLIC,
Humphreys (Howard) and Partners, Leatherhead (England).
For primary bibliographic entry see Field 4B.
W86-05673

GROUNDWATER RESOURCES DEVELOPMENT IN INDIA,
Minor Irrigation Dept., Lucknow (India).
For primary bibliographic entry see Field 4B.
W86-05674

DEVELOPMENT OF GROUNDWATER RESOURCES IN THE NETHERLANDS,
Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
For primary bibliographic entry see Field 4B.
W86-05675

IMPACT OF A FUTURE QATTARA SALTWATER LAKE ON THE NUBIAN SANDSTONE AQUIFER SYSTEM IN THE WESTERN DESERT, EGYPT,
Organization for Land Reclamation and Agriculture Development Projects, Cairo (Egypt).
For primary bibliographic entry see Field 4B.
W86-05676

GROUNDWATER REGIME FORECASTING WITH INADEQUATE DATA IN ARGENTINA,
La Plata Univ. (Argentina).
For primary bibliographic entry see Field 4B.
W86-05677

SIMULATION MODEL FOR THE MANAGEMENT OF GROUNDWATER IN THE YUN-LIN BASIN,
National Taiwan Univ., Taipei. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W86-05678

GROUND WATER IN WATER RESOURCES PLANNING.
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
For primary bibliographic entry see Field 4B.
W86-05679

EFFECTS OF INSUFFICIENT RECHARGE FOR AQUIFER LAYERS IN AIN BENI MATHAR (OUJDA PROVINCE, EAST MORROCO) (ALIMENTATION INSUFFISANTE DES COUCHES AQUIFERES ET SES CONSEQUENCES DANS LA REGION D'AIN BENI MATHAR (PROVINCE D'OUJDA, MAROC ORIENTAL)),
Erlangen-Nuernberg Univ. (Germany, F.R.). Inst. fuer Geographie.
For primary bibliographic entry see Field 4B.
W86-05682

GROUNDWATER DEVELOPMENT AS AN INTEGRAL PART OF RIVER BASIN RESOURCE SYSTEMS,
Severn-Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 4B.
W86-05687

GROUND-WATER RESOURCES: PRINCIPLES FOR THEIR DEVELOPMENT AND UTILIZATION,
Belorusskii Nauchno-Issledovatelskii Inst. Melioratsii i Vodnogo Khozyaistva, Minsk.
For primary bibliographic entry see Field 4B.
W86-05688

CALIBRATION STRATEGY FOR GROUNDWATER MODELS,
D. Briechle, and P. Huber.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 717-722, 2 fig.

Descriptors: *Calibrations, *Groundwater models, Model transmissivity, Water table, Contour maps, Model studies.

The problems involved in calibrating groundwater models, and recommendations given on how to

obtain best results are discussed. After explaining the meaning of 'model transmissivity' and indicating possible difficulties when reproducing a water table contour map by the element structure of a model, emphasis is put on the implications given by different approaches to calibration. Practicable solutions are given on how to circumvent adverse constellations which may seriously affect the results of calibration. (See also W86-05679) (Author's abstract)
W86-05694

PROGNOSTIC STUDY OF WATER LEVELS FOR EVALUATING THE HYDROGEOLOGICAL CHARACTER OF SHADNAGAR BASIN, (A.P.), INDIA,

Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
B. H. Briz-Kishore.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 723-734, 3 fig, 2 tab, 8 ref.

Descriptors: *Model studies, *Groundwater depletion, *Groundwater recharge, *Hydrogeological features, *Shadnagar Basin, *India, Algorithms, Mathematical studies, Water level fluctuations, Water level.

Quantification of aquifer parametric data and its use for forecasting have increased enormously in recent years with the advent of numerical algorithms to describe or simulate subsurface hydrology. The algorithms are more widely useful through the design of software for small machines with disc supported facilities and development of optimization methods for micro processors. Prognostic study involves quantitative estimation of future water levels with increased draft conditions while recharge is more or less constant. However, in the present work the prognostic study is utilized to evaluate the hydrogeological characters regarding movement and utilization of ground water. It was thought that the entire recharge from the Shadnagar system in India could be utilized; such exploitation of complete recharge could arrest all subsurface losses from the basin. A digital model was designed and developed for the Shadnagar basin. Large portions of the basin show a decline in water levels for a draft of 37 MCM in 1991 when total recharge is 44 MCM. Also substantial decline is forecast in water levels for the year 2001 with large portions of the area showing drawdowns greater than 2 m indicating that the entire basin would be overexploited. From the model and field studies it can be concluded that the ground water is irrecoverably lost. Further, the simulated water levels show that increasing draft from 37 MCM to 44 MCM in the period 1991 to 2001, would cause decline in water levels not commensurate with the increased draft. Complete arrest of such losses is not possible as the basin's topographic gradients would cause decline in water levels even when the draft is equal to the recharge. These observations reveal that the entire recharge to the ground water system could be utilized only by creating ground water sink conditions in all segments of the basin where the trend of the flow from the outfall areas can be altered. These observations modify the earlier belief that the exploitable reserve could be equal to net annual recharge. (See also W86-05679) (Lantz-PTT)
W86-05695

REGIONAL WATER RESOURCES SIMULATION WITH STREAM AQUIFER INTERACTION, SENSITIVITY ANALYSIS AND INVERSE MODELLING,

Indian Inst. of Tech., New Delhi.
M. C. Chaturvedi, and C. V. Ramakrishna.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 735-763, 14 fig, 14 ref.

Descriptors: *Inverse modeling, *Groundwater simulation, *Model studies, *Sensitivity analysis, *Surface-groundwater relations, Water resources development, Aquifers, Yamuna Basin, India, Delhi, River basins, Mathematical studies.

Regional ground-water simulation for the Upper Yamuna Basin in India, covering an area of about 11,500 sq km from the Himalayas to Delhi, was carried out in the context of policy and systems studies. A finite element model was developed. The issue of flux generation through inverse modelling and stream-aquifer interaction were specifically developed. The basin, developmental issues, and data base are briefly described. The basin was discretized with 207 elements which were quadratic-isoparametric with varying dimensions. Each element had eight nodes, viz. four corner nodes and four mid-side nodes to give a total of 688 nodes. Calibration was done for 100 nodes and typical results are given. Sensitivity analysis for several parameters was carried out in terms of three statistical bases. Inverse modelling on basis of control theoretic approach has been developed and is also presented. (See also W86-05679) (Author's abstract)
W86-05696

COMPARISON BETWEEN DIFFERENT METHODS OF ARTIFICIAL GROUND-WATER RECHARGE,

Tongji Univ., Shanghai (China). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 4B.
W86-05699

ARTIFICIAL GROUNDWATER RECHARGE USING HIGH-WATERS OF STREAMS,

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
For primary bibliographic entry see Field 4B.
W86-05700

EVALUATION OF LONG-TERM GROUNDWATER LEVEL MEASUREMENTS FROM THE HEINSCHENWALDE GROUNDWATER EXPLOITATION AREA,

Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
For primary bibliographic entry see Field 4B.
W86-05701

SMALL MODELS FOR THE SIMULATION OF GROUNDWATER FLOW (MINIATURISATION DES MODELES D'ECOULEMENT SOUTERRAIN),

Paris-6 Univ. (France).
P. Hubert, and J. Leon.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 829-841, 5 fig, 2 ref.

Descriptors: *Model studies, *Simulation analysis, *Groundwater movement, Small models, Water resources management.

A model for simulation is a logical and handy synthesis of information. It offers an irreplaceable help in water resouces management. In order not to submit the results of simulation in too rigid a way, the authors propose the development of small and simple models for simulation, easily usable by managers. An example of this type of model is presented. (See also W86-05679) (Author's abstract)
W86-05702

MATHEMATICAL MODELS OF GROUNDWATER BASINS: THEIR APPLICATION FOR STUDY AND MANAGEMENT OF HYDROGEOLOGICAL PROCESSES,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
G. V. Kulikov, and I. I. Krashin.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 853-864, 2 ref.

Descriptors: *Mathematical models, *Groundwater basins, *Hydrogeological processes, Computer models, Groundwater management, Groundwater potential, Model studies.

The development of regional changes in the hydrogeological conditions resulted in the construction of mathematical models of large ground-water basins for recording and predicting the impact of various complexes of technogenetic and natural factors. The necessity to solve more complicated regional hydrogeological tasks under present conditions determined an evolution of the concept, and a development of automatic, constantly functioning models of hydrogeological regions, representing man-machine information computer systems for the prediction and management of hydrogeological processes. (See also W86-05679) (Author's abstract)
W86-05704

DEVELOPMENT OF GROUNDWATER RESOURCES UNDER CONSIDERATION OF LEAKAGE FLOW IN THE HALTERNER SANDE, FEDERAL REPUBLIC OF GERMANY,

Technische Hochschule Aachen (Germany, F.R.). Lehrgebiet Hydrogeologie.
For primary bibliographic entry see Field 4B.
W86-05705

QUANTITATIVE ASPECTS FOR DETERMINING WATER TABLE RESOURCES: RECENT APPLICATIONS IN BRITTANY, FRANCE (ASPECTS QUANTITATIFS DES RESSOURCES EN EAU EN REGION DE SOCLE METHODES APPLIQUEES AU CAS DE LA BRETAGNE, EN FRANCE),

Bureau de Recherches Geologiques et Minieres, Orleans (France).
P. A. Roche, H. Talbo, and D. Thiery.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 901-916, 4 fig, 11 ref.

Descriptors: *Water table, *Groundwater availability, *Brittany, *France, Water resources development, Boreholes, Borehole geophysics.

The hydrogeological environment of an hercynian and metamorphic rocks zone, Brittany, is briefly described. Newly derived methods to determine the different scales are reviewed, so that a better evaluation of water resources can be established. These methods which may be used after the development of new techniques for drilling boreholes. (See also W86-05679) (Author's abstract)
W86-05708

GROUNDWATER LEVEL MANAGEMENT IN THE PLAIN OF ALSACE IN MOYEN: MODEL SIMULATIONS AND INFORMATION EXCHANGE (GESTION DE LA NAPPE PHREATIQUE DE LA PLAINE D'ALSACE AU MOYEN D'UNE BANQUE DE DONNEES ET DE MODELS DE SIMULATION),

Bureau de Recherches Geologiques et Minieres, Strasbourg (France).
J. P. Vancon.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 941-947, 2 ref.

Descriptors: *Groundwater level, *Groundwater management, *Simulation analysis, *Information exchange, *Alsace, France, Hydrodynamic models, Hydrochemical models, Hydrothermic models, Computer models, Heat pumps, Industrial wastes, Thermal pollution.

Within the scope of the Rhine alluvial plain investigation, a complete tool for the management of groundwater resouces has been perfected at the 'Service Geologique Regional Alsace' of BRGM. It includes simulation models (hydrodynamic, hydrochemical and hydrothermic models) backed by a computerized background made up of the bank

of groundwater data and its working procedure. The models lead to the best choice in groundwater development and utilization in relation to resources, to industrial pollution and to thermal disturbances related to heat pumps. (See also W86-05679) (Author's abstract)
W86-05711

GROUNDWATER STUDIES FOR LIMA, PERU,

Binnie and Partners, London (England).
D. N. Lerner, M. Mansell-Moulin, D. J. Dellow, and J. W. Lloyd.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 17-30, 6 fig.

Descriptors: *Groundwater, *Data collections, *Water allocation, *Lima, *Peru, Water supply, Arid lands, Aquifers, Model studies, Recharge, Groundwater recharge, Alluvial deposits, Rimac River, Chillon River, Infiltration, Drawdown.

The groundwater resources of Lima, Peru, and alternative forms of further developments were examined. Extensive groundwater exists in the Quaternary alluvial fan sediments which over lie an impermiable pre-Quaternary basement. The aquifer has two branches, in the Rimac and Chillon river valleys, which combine near the coast. A groundwater balance study shows that precipitation provides no recharge to the aquifer. River channel infiltration occurs mainly during January-April. Infiltration from water supply systems, canals, and irrigation was 66% greater than natural recharge. Water abstractions were 9.7 cu m/sec in 1978. Groundwaters are predominately calcium sulfate type, some exceeding 1000 mg/liter sulfate. The greatest constraint on future water development is the apparent decrease in the aquifer's permeability with depth. Seawater intrusion is already occurring in the Callao area, and future development would make this situation worse. Urban development on irrigated land and leakage detection programs will probably increase the recharge by 1.0 cu m/sec by 2000. Model studies showed that increasing groundwater abstractions would cause large areas of greater drawdowns, up to 40 m in some areas. Possible alternative schemes include increased direct abstractions, conjunctive use of surface water and groundwater, increased trans-Andean transfers, and artificial recharge. (See also W86-05750) (Author's abstract)
W86-05752

NEW TRITIUM INTERFACE METHOD FOR DETERMINING THE RECHARGE RATE OF DEEP GROUNDWATER IN THE BAVARIAN MOLASSE BASIN,

Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
G. Andres, and R. Egger.
Journal of Hydrology JHYDA7, Vol. 82, No. 1/2, p 27-38, November 1985. 4 fig, 8 ref.

Descriptors: *Recharge, *Tracers, *Tritium interface method, *Discharge rate, *Groundwater recharge, Molasse Basin, Bavaria, Aquifers, Wells.

A new, inexpensive method for estimating recharge rates of deep groundwater was investigated using the aquifer in the Bavarian Molasse Basin as the study area. The tritium interface method proved to be hydrogeologically plausible and realistic, with data from 153 wells. The depth of interface between tritium-bearing and tritium-free groundwater, together with the hydraulic conductivity of the leaky layer overlying the aquifer and the duration of anthropogenic tritium input, showed recharge rates that were comparable calculated by other mathematical means. (Adams-PTT)
W86-05837

INFLOW SEEPAGE INFLUENCE ON STRAIGHT ALLUVIAL CHANNELS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-05855

SIMULATION OF TWO-FLUID RESPONSE IN VICINITY OF RECOVERY WELLS,

Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
G. P. Lennon.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No.8, p 1156-1168, August 1985, 8 fig, 1 tab, 15 ref, append.

Descriptors: *Water pollution control, *Groundwater pollution, *Wells, *Aquifers, *Skimming wells, Simulation, Unconfined aquifers, Boundary integral equation method, Numerical analysis, Axisymmetric geometry, Mathematical analysis, Groundwater.

A dense fluid in an unconfined aquifer is unsually removed by pumping a recovery well screened in the region of the aquifer occupied by the fluid. For many problems, the transition zone separating the dense fluid from the overlying water can be modeled as a sharp interface. When pumping begins, the interface is drawn downward, allowing water to enter the well. The recovery process is improved if a second well is drilled and screened in the interface to move upward, allowing the dense fluid to be recovered at an increased rate without water entering the recovery well. The boundary integral equation method (BIEM) is used to solve the problem of the response of a dense fluid near a recovery well in a groundwater aquifer. The axisymmetric problems considered are time-dependent and involve a nonlinear boundary condition along the free surface as well as a nonlinear, moving interfacial boundary. The entire boundary, including the moving boundaries, are discretized into axisymmetyric finite elements for evaluating the required boundary integrations. Numerical examples include pumping both fluids simultaneously as well as separately. The model is used to illustrate the design of a recovery system for the efficient removal of the dense fluid. The model may also be applied to problems of hazardous fluid recovery or to improve the effectiveness of 'skimming wells' in a saltwater/freshwater aquifer. (Jones-PTT)
W86-05857

MODERN TECHNIQUES IN WELL DESIGN,

Geoscience Support Services, Inc., Pomona, CA.
For primary bibliographic entry see Field 8A.
W86-05870

ARTESIAN AND ANISOTROPIC EFFECTS ON DRAIN SPACING,

Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics.
For primary bibliographic entry see Field 4B.
W86-05927

ABSTRACTION AND RECHARGE WELL IN UNIFORM SEEPAGE,

Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W86-05986

DESIGN AND IMPLEMENTATION OF GROUNDWATER RECOVERY SYSTEMS,

Underground Resource Management, Inc., Austin, TX.
For primary bibliographic entry see Field 5G.
W86-06084

SPRING CHARACTERISTICS AND HYDROLOGICAL MODELS OF CATCHMENTS, A CASE STUDY FROM ASTDALEN, S.E. NORWAY,

Norges Landbrukshoegskole, Aas. Dept. of Geology.
J. -O. Englund.
Nordic Hydrology, Vol. 17, No. 1, p 1-20, 1986. 8 fig, 4 tab, 28 ref.

Descriptors: *Hydrologic models, *Springs, *Catchment areas, *Rainfall-runoff relations, *Surface-groundwater relations, Scandinavia, Asta River, Sedimentary rocks, Groundwater, Rivers, Snowmelt, Norway, Porosity, Streamflow, Ammonium, Potassium, Nitrates, Chlorides, Rainfall.

The runoff process in the Astdalen catchment is governed by large accumulations of snow, large areas covered by peatlands, and a high water storage capacity in the bedrocks. Groundwater discharge occurs in river beds, springs and as surface flow, especially toward peatland areas. Discharges from the Asta River, and from investigated springs, rose rapidly following snowmelt and rainstorms during the two year study, from October 1, 1980 to September 30, 1982. This shows that the catchment has a high infiltration capacity, and that water moves rapidly downslope in the saturated zone, following macropores in soils, peatlands and bedrock fractures. Groundwater, especially shallow groundwater, plays an important role in streamflow peak generation, even during snowmelt. About 60-70% of the river discharges during the melting periods in 1981 and 1982, were baseflow. There was a net gain of protons, ammonium, potassium, nitrate and chloride to the catchment from the atmosphere during the year, with a net loss of calcium, magnesium, sodium and sulfate. Constituents showing a net loss had an internal geologic and/or organic source in addition to the atmosphere. The concentration of most substances in the Asta River and in the investigated springs are lower during peak flows. The concentration of protons is, on the other hand, typically increased during snowmelt, indicating that fresh rain and/or snowmelt water dominates such flow periods and not older prestorm water. About 56% of the protons needed to supply the weathering-derived ions to the Asta River came from precipitation. (Lantz-PTT)
W86-06163

DEPENDENCE OF EFFECTIVE POROSITY ON FRACTURE CONTINUITY IN FRACTURED MEDIA,

ENVIRON Corp., Washington, DC.
M. J. Gordon.
Ground Water GRWAAP, Vol. 24, No. 4, p 446-452, July-August 1986. 7 fig, 3 tab, 9 ref.

Descriptors: *Fracture permeability, *Groundwater movement, *Geologic fractures, *Porosity, *Continuity, Porous media, Hydrologic models, Model studies, Tracers, Flow profiles.

Fractured geologic media are typically considered to behave as equivalent porous-media continua for the purposes of hydrologic testing and modeling. The equivalent-continuum effective porosity of a fractured medium is frequently measured using tracer tests performed over distances that are relatively small when compared to the scale of interest in hydrologic and transport modeling. The larger-scale value of effective porosity can differ from the smaller-scale measured value by several orders of magnitude, depending in part on the relative degree of fracture continuity between inflow and outflow zones at the different scales. Based on the results of this simplified numerical modeling study several conclusions may be inferred: 1) the continuity of fractures in a fractured medium profoundly affects the equivalent-continuum effective porosity of the medium. The equivalent-continuum effective porosity appears likely to substantially increase with decreased continuity. Based on the development of a breakthrough curve for a discontinuously fractured medium, it appears that the equivalent-continuum effective porosity determined from a tracer test in a discontinuously-fractured volume of rock may be weighted more heavily towards the matrix effective porosity than towards the equivalent-continuum effective porosity of the fractured portion of the domain. The representativeness, in terms of fracture continuity, of the tested volume of rock at the larger scale of interest to transport predictions must be considered prior to extrapolation of the measured value to the larger scale; 2) in a fractured medium, neither the rock matrix effective porosity nor the apparent porosity of the medium should be confused with the equivalent-continuum effective porosity, even if the fractures are discontinuous. These quantities

can differ by orders of magnitude; and 3) A substantial amount of dispersion can arise from the heterogeneity of a discontinuously-fractured medium. This can cause early breakthrough of some of the tracer mass, which may be important if the time of first appearance of tracer at a downgradient boundary is of interest. (Lantz-PTT)
W86-06167

HYDROLOGIC BUDGET ANALYSIS FOR THE NILE VALLEY IN EGYPT,

Ministry of Irrigation, Cairo (Egypt). Research Inst. for Groundwater.
F. A. R. Attia, M. N. Allam, and A. W. Amer.
Ground Water GRWAAP, Vol. 24, No. 4, p 453-459, July-August 1986. 6 fig, 4 tab, 7 ref.

Descriptors: *Hydrologic budget, *Nile River, *Egypt, *Mathematical models, Hydrologic models, Surface-groundwater relations, Flow rate, Model studies, Groundwater depletion, Groundwater recharge, Water resources planning, Groundwater management.

A two-dimensional finite-element model has been adapted to simulate the aquifer underlying the Nile Valley of Egypt. Calibration of the model led to the determination of the interaction between the groundwater and the Nile surface water. The water balance computations indicate that the surface drainage component is about double the component of groundwater seepage to the Nile. The monthly sum of both components (groundwater seepage to the river (Gw) + drainage water disposed in the river (Dr sub v)) was maximum in November (1.02 times 10 to the 9th power cu m) when applied irrigation water is made to satisfy leaching requirements. It was minimum in January (70,000,000 cu m) during winter closure. Values of the net groundwater flow to the Nile obtained from the application of the model, were in the range of values obtained from the analytical water budget analyses. Reaches of relatively high and low seepage were more easily identified in the model application. The value of the net annual groundwater seepage to the Nile in the reach Edfu-El Wasta, as obtained in the model, was estimated at about 2.1 times 10 to the 9th power cu m. Adding the values of the groundwater withdrawals and evaporation through the capillary fringe to this amount (4.0, 9.0, and 3.0 times 10 to the 9th power cu m/yr in 1980), the total annual net recharge to the groundwater aquifer in the region amounts to about 3.7 times 10 to the 9th power cu m/yr. The model was considered to adequately represent the groundwater system of the Nile Valley and may be used to forecast the effects of managing the integrated groundwater/surface water system. (Lantz-PTT)
W86-06168

RELATIONS BETWEEN PERMEABILITY AND ELECTRICAL RESISTIVITY IN GRANULAR AQUIFERS,

San Diego State Univ., CA. Dept. of Geological Sciences.
D. Huntley.
Ground Water GRWAAP, Vol. 24, No. 4, p 466-474, July-August 1986. 9 fig, 1 tab, 19 ref.

Descriptors: *Permeability, *Electrical properties, *Resistivity, *Aquifers, Quantitative analysis, Porosity, Conductivity, Hydraulic properties, Geohydrology.

Increased demand for quantitative answers to groundwater problems, particularly those associated with the use of numerical models, has increased the need to accurately determine the distribution of hydraulic parameters. Researchers have attempted to find correlations between electrical resistivity and the permeability of fresh water aquifers since 1951. Several recent studies report either direct or inverse relations between apparent formation factor and aquifer permeability. The basis for these relations is a direct or inverse relationship between porosity and permeability and, as matrix conduction effects are not taken into account, constant fluid conductivity is either implicitly or explicitly assumed. Laboratory experiments conducted on granular materials suggest that matrix conduction (surface conduction) effects are either as important as, or dominant over, porosity-permeability relations. These experiments, on granular materials, show only weak relations between true formation factor and permeability. Relations between apparent formation factor and permeability are good only for constant fluid conductivity. Most importantly the strongest relationship found was that between permeability and matrix conductivity. These data suggest either that (1) relations between permeability and apparent formation factor must be applied in very restricted geologic environments and only where fluid conductivity remains relatively constant, or (2) more fundamental relations between matrix conductivity and aquifer permeability should be applied. (Author's abstract)
W86-06170

GEOCHEMICAL INVESTIGATIONS OF THREE TROPICAL KARST DRAINAGE BASINS IN PUERTO RICO,

Pennsylvania State Univ., University Park. Dept. of Geosciences.
For primary bibliographic entry see Field 2E.
W86-06171

GROUND-WATER RECHARGE AND ITS EFFECTS ON NITRATE CONCENTRATION BENEATH A MANURED FIELD SITE IN PENNSYLVANIA,

Geological Survey, Towson, MD. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-06172

FINITE-DIFFERENCE GRID FOR A DOUBLET WELL IN AN ANISOTROPIC AQUIFER,

Geological Survey, St. Paul, MN. Water Resources Div.
R. T. Miller, and C. I. Voss.
Ground Water GRWAAP, Vol. 24, No. 4, p490-496, July-August 1986. 8 fig, 1 tab, 7 ref.

Descriptors: *Groundwater movement, *Aquifers, *Anisotropy, *Wells, Graphical analysis, St. Paul, Minnesota, Energy transfer, Transmissivity, Mathematical studies, Electrical properties, Injection wells, Hydraulic flow, Finite difference analysis.

Models are designed for hydraulic flow and thermal-energy transport at a two-well injection/withdrawal system in St. Paul, Minnesota. The design of the finite-difference model grid for the doublet-well system is complicated because the aquifer is anisotropic and the principal axes of transmissivity are not aligned with the axis between the two wells. Flow net analysis was used to determine water flux across an equipotential boundary and to assign approximate flux values at model boundaries. This enabled the simulation of the effects of the entire flow field, although only a small part was modeled. The validity of the flux values at the model boundaries for the isothermal case was tested by simulation of an eight day injection test of ambient temperature water. Model computed pressures compared very favorably with field observed pressures. The validity of boundary-flux values also was tested for nonisothermal conditions by simulation of injection of 300 F water at 300 gallons/minute, for eight days. (Lantz-PTT)
W86-06173

STRATA-MOVEMENT CONCEPTS AND THE HYDROGEOLOGICAL IMPACT OF UNDERGROUND COAL MINING,

Northern Illinois Univ., De Kalb. Dept. of Geology.
For primary bibliographic entry see Field 4C.
W86-06175

2G. Water In Soils

CORRELATIONS BETWEEN NIMBUS-7 SCANNING MULTICHANNEL MICROWAVE RADIOMETER DATA AND AN ANTECEDENT PRECIPITATION INDEX,

Texas A and M Univ., College Station. Dept. of Meteorology.
For primary bibliographic entry see Field 2B.
W86-05476

MOISTURE CURVE OF COMPACTED CLAY; MERCURY INTRUSION METHOD,

Purdue Univ., Lafayette, IN.
For primary bibliographic entry see Field 8D.
W86-05556

MECHANISM OF VERTICAL WATER MOVEMENT IN KANTO LOAM DURING AND AFTER RAINFALL,

Tsukuba Univ. (Japan). Inst. of Geoscience.
I. Kaihotsu, and T. Tanaka.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 169-177, 9 fig, 15 ref.

Descriptors: *Groundwater recharge, *Groundwater movement, *Soil water, *Natural recharge, *Loam, Rainfall, Rainfall-runoff relationships, Tensiometers, Soil moisture meters, Infiltration, Water table, Hydrologic budget, Permeability coefficient, Japan, Moisture meter.

Field observations were conducted to clarify the mechanism of groundwater recharge in the Kanto Loam volcanic ash soil covering diluvial uplands in the Kanto District of Japan. Water contents were measured by a neutron scattering moisture meter, and pressure heads of soil water were obtained simultaneously from tensiometers. The field data showed that the water table begins to rise instantaneously when the wetting front reaches the top of the capillary fringe and at the same time the water content and the pressure head of the capillary fringe decreases. The mechanism of this rapid response of the water table to the rainwater movement cannot be explained with the usual unsaturated flow model. The reason for the rapid response of the water table to rain is the disturbance of the hydrostatic potential balance at the top of the capillary fringe. The rate of groundwater recharge in the study area was calculated to be 3.4 millimeters/day. (See also W86-05645) (Geiger - PTT)
W86-05663

COMPLEX EFFECT OF SOME AGRONOMICAL PROCEDURES AND HYDROMETEOROLOGICAL FACTORS ON THE WATER BUDGET OF THE SOIL,

Debrecen Univ. of Agrarian Sciences (Hungary).
For primary bibliographic entry see Field 3F.
W86-05685

MODEL FOR ESTIMATING TIME-VARIANT RAINFALL INFILTRATION AS A FUNCTION OF ANTECEDENT SURFACE MOISTURE AND HYDROLOGIC SOIL TYPE,

Maryland Univ., College Park.
H. A. Wilkening, and R. M. Ragan.
Available from the National Technical Information Service, Springfield, VA. 22161 as N83-16817, Price codes: A05 in paper copy, A01 in microfiche. Report No. CP-52-04372, October 1982. 98 p, 28 fig, 7 tab, 19 ref, 2 append.

Descriptors: *Soil water, *Remote sensing, *Infiltration rate, *Rainfall infiltration, Richards equation, Soil type, Antecedent moisture, Model studies, Hydrologic models, Rainfall-runoff relationships, USDAHL model, SSARR model, Storage, Water storage, Soil properties.

Recent research indicates that the use of remote sensing techniques for the measurement of near surface soil moisture could be practical in the not too distant future. Other research has shown that infiltration rates, especially for average or frequent rainfall events, are extremely sensitive to the proper definition and consideration of the role of soil moisture at the beginning of the rainfall. Thus it is important that easy to use, but theoretically

sound, rainfall infiltration models be available if the anticipated remotely sensed soil moisture data is to be optimally utilized for hydrologic simulation. A series of numerical experiments with the Richards equation for an array of conditions anticipated in the watershed hydrology were used to develop functional relationships that describe temporal infiltration rates as a function of soil type and initial moisture conditions. (Author's abstract)
W86-05792

OXIDATION-INDUCED LEACHING OF SULPHATE AND CATIONS FROM ACID SULPHATE SOILS,

Helsinki Univ. (Finland). Dept. of Agricultural Chemistry.
H. Hartikainen, and M. Yli-Halla.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 1-2, p 1-13, January 1986. 2 fig, 4 tab, 28 ref.

Descriptors: *Acid soils, *Sulfates, *Water pollution sources, *Oxidation, *Soil chemistry, Chemical properties, Cations, Leaching, Drainage effects, Hydrogen ion concentration, Iron, Aluminum, Manganese, Potassium, Calcium, Magnesium, Sodium oxidation.

Laboratory studies on the leaching of sulfate and cations from horizon samples of two acid sulfate soils were conducted. The leachates were analyzed for pH, SO4-S, Fe, Al, Mn, K, Ca, Mg, and Na. Oxidation of sulfide was retarded at lower temperatures. From all the originally water-logged samples the sulfate formed was initially washed out with base cations (mainly with Mg), but the proportion of acid counter ions (predominantly Al) increased with proceeding oxidation and acid formation. In the most acid leachates, pH was 2.6 to 2.8. In the transition layer between reduced and oxidized horizons, sulfide oxidation had been going on for some time, and acid cations were the main counter ions for sulfate already at the beginning of the experiment. In the totally oxidized surface horizons, sulfates were leached only in moderate quantities, and the sum of cation equivalents (mainly base species) exceeded that of sulfate, suggesting some removal of other anions. These results point out the environmental danger associated with deep drainage of potentially acid sulfate soils. (Doria-PTT)
W86-05909

ADSORPTION OF MERCURY COMPOUNDS BY TROPICAL SOILS,

Norges Landbrukshoegskole, Aas. Dept. of Soil Fertilization and Management.
E. Semu, B. R. Singh, and A. R. Selmer-Olsen.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 1-2, p 19-27, January 1986. 3 fig, 2 tab, 24 ref.

Descriptors: *Adsorption, *Mercury, *Path of pollutants, *Soil chemistry, *Tropical regions, Tanzania, Morogoro, Arusha, Dar es Salaam, Hydrogen ion concentration, Organic carbon, Cation exchange, Aretan.

Mercury adsorption of HgCl2 and 2-methoxyethylmercury chloride (Aretan) (100 mg Hg/l) was measured for three soil profiles from Morogoro, Arusha, and Dar es Salaam in Tanzania. The adsorption was investigated for the physical, chemical, and mineralogical properties of the soils. All soil samples showed greater capacity for adsorption of Aretan than for HgCl2. In the Morogoro profile Hg adsorption decreased with depth but in the other two soils, the minimum adsorption occurred in the third horizon and increased both upwards and downwards. Aretan adsorption correlated well with pH in the Morogoro profile. Adsorption of both Aretan and HgCl2 correlated well with the distribution of organic carbon and with the cation exchange capacity of the soils. In the Arusha and Dar es Salaam profiles Hg adsorption was not significantly correlated with any of the soil properties tested. (Doria-PTT)
W86-05911

EFFECTS OF CLAY-SOLUTION INTERACTIONS ON WATER RETENTION,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
R. J. Lenhard, and R. H. Brooks.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 1, p 28, February 1986. 6 fig, 1 tab, 17 ref.

Descriptors: *Clay, *Retention capacity, *Soil moisture retention, Montmorillonite, Hydraulic properties, Soil mechanics, Water chemistry.

Capillary pressure-saturation data were measured on unconsolidated porous media containing 40% montmorillonite, as a function of total electrolyte concentration and sodium adsorption ratio (SAR) of the wetting fluid. Data were also obtained with a nonpolar wetting fluid. The Su-Brooks retention function was fit to the experimental data. The average R(2) for all treatments was 0.9967. The liquid retention curves were scaled to account for differences in properties of the wetting fluids. The change in scaled liquid retention curves due to changes in solution concentration and SAR followed a pattern reported by earlier investigators, except at high solution concentrations. There were significant clay-solution interactions which affected the retention of solution at high electrolyte concentrations. Previous researchers assumed that at high solution concentrations clays did not swell sufficiently to affect hydraulic properties. (Doria-PTT)
W86-05925

NONDESTRUCTIVE OBSERVATIONS OF SOLUTION DISPLACEMENT IN SOILS,

California Univ., Davis. Dept. of Land, Air and Water Resources.
M. E. Grismer.
Soil Science SOSCAK, Vol. 141, No. 3, p 185-189, March 1986. 3 fig, 2 tab, 12 ref.

Descriptors: *Soil water movement, *Saline soils, Soil solution, *Irrigation, *Unsteady flow, Salt, Agriculture, Dual source gamma-attenuation, Boundary flux, Dispersion coefficient, Soil chemistry, Solute transport, Solution displacement.

Solution displacement processes are important to irrigated agriculture in salt-affected soils. The experiments described here explore solution displacement processes during transient unsteady flow in unsaturated soil. Changing solution contents and salt concentrations were determined from nondestructive experimental techniques that employed a dual-source gamma-attenuation system. In general, complete displacement of antecedent water by infiltrating solution was observed. Complete displacement, however, depended on the boundary flux and initial solution content of the soil. Dependence of the dispersion coefficient on solution content was also determined from one of the experiments. (Author's abstract)
W86-06008

NUMERICAL TECHNIQUE FOR MODELING TRANSIENT FLOW OF WATER TO A SOIL WATER SAMPLER,

California Univ., Berkeley. Lawrence Berkeley Lab.
T. N. Narasimhan, and S. J. Dreiss.
Soil Science SOSCAK, Vol. 141, No. 3, p 230-236, March 1986. 9 fig, 1 tab, 6 ref. DOE DE-AC03-76SF00098.

Descriptors: *Soil water, *Soil water movement, *Sampling, *Soil moisture meters, *Soil pressure, Mathematical models, Integral finite difference method, Boyle's Law, Air pressure, Vadose water, Numerical analysis.

The soil water sampler is a widely used device for collecting water from the vadose zone. Previous users attempting to mathematically model the fluid flow around a sampler have treated the sampler as a prescribed potential (Dirichlet) boundary condition. Physically, the sampler is a finite volume of space in which the air pressure changes as the water level rises within. This change in air pressure can be a dominant factor that controls the transient flow of water into the sampler. An important consequence of the air-pressure effect is that the volume of sample that can be collected and the radius of influence of the sampler are both functions of the void volume of the sampler. A numerical technique in the context of the integral finite difference method is proposed to simulate the behavior of a pneumatically sealed water sampler that extracts water from a partially saturated soil. This technique uses Boyle's Law to estimate the changing effective suction in the sampler. (Author's abstract)
W86-06009

SALINITY OF MOTORWAY SOILS. I. VARIATION IN TIME AND BETWEEN REGIONS IN THE SALINITY OF SOILS ON CENTRAL RESERVES,

Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
For primary bibliographic entry see Field 5B.
W86-06033

SALINITY OF MOTORWAY SOILS. II. DISTANCE FROM THE CARRIAGEWAY AND OTHER SOURCES OF LOCAL VARIATION IN SALINITY,

Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
For primary bibliographic entry see Field 5B.
W86-06034

TIME SERIES MODELING OF COASTAL CURRENTS,

Middle Georgia Coll., Cochran. Dept. of Mathematics.
D. A. Chin, and P. J. W. Roberts.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 111, No. 6, p 954-972, November 1985, 6 fig, 6 tab, 12 ref.

Descriptors: *Model studies, *Time series modeling, *Coastal currents, Time domain models, Frequency domain models, Cross-autoregressive integrated models, Spectral component models, San Francisco, California.

Time and frequency domain models that relate a vector time series at any location to a measured series at another location are evaluated by application to the prediction of coastal currents. The time domain model belongs to the general class of cross-autoregressive integrated (CARI) models based on classical time series analysis methods. The frequency domain model is a spectral component (SC) model, which relates the Fourier spectrum at different stations. The errors resulting from the use of both model types to predict measured currents off San Fransisco, California, were computed. Of the CARI models, a six parameter model was best, although a simpler three parameter model was almost as good. The main drawback to the CARI model was the nonstationarity of the formulation, requiring several years of data to develop a stationary model for a particular season. The SC model was more stationary and had smaller errors than the best CARI model. It is concluded that frequency domain models are the best method of predicting two-dimensional vector time series from other series. (Author's abstract)
W86-06113

SOIL SORPTION OF ORGANIC VAPORS AND EFFECTS OF HUMIDITY ON SORPTIVE MECHANISM AND CAPACITY,

Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W86-06138

DEPENDENCE OF EFFECTIVE POROSITY ON FRACTURE CONTINUITY IN FRACTURED MEDIA,

ENVIRON Corp., Washington, DC.
For primary bibliographic entry see Field 2F.
W86-06167

2H. Lakes

MORPHOLOGY AND CONTENT OF DRY MATTER AND SOME ELEMENTS IN CELLS AND STALKS OF NEVSKIA FROM AN EUTROPHIC LAKE,

Bergen Univ. (Norway). Dept. of Microbiology and Plant Physiology.
For primary bibliographic entry see Field 5A.
W86-05419

ENUMERATION AND IDENTIFICATION OF HETEROTROPHIC BACTERIA IN GROUNDWATER AND IN A MOUNTAIN STREAM,

Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research.
J. M. Buchanan-Mappin, P. M. Wallis, and A. G. Buchanan.
Canadian Journal of Microbiology CJMIAZ, Vol. 32, No. 2, p 93-98, February 1986. 3 tab, 23 ref.

Descriptors: *Heterotrophic bacteria, *Water quality, *Groundwater quality, Mountains, Alberta, Canada, Epifluorescence microscopy, Culturing techniques, Plate counts, Bacterial analysis, Pseudomonas, Bacillus, Algae.

Populations of heterotrophic bacteria were enumerated from stream and groundwater samples taken from an undisturbed catchment basin in southwestern Alberta. Direct counts using epifluorescence microscopy were compared with total viable counts using standard plate count methods, the iodonitrotetrazolium formazan method (reduction of 2-(p-iodophenyl)-3-(p -nitrophenyl)-5-phenyl tetrazolium chloride to iodonitrotetrazolium formazan), the nalidixic acid method, and the slide culture method. The nalidixic acid method gave the highest results, with total viable counts as high as 34.6% of the total direct count. Attempts to enumerate bacteria on media made from decaying leaves and algal-bacterial slime gave lower values, approximately 10% of the numbers obtained on enriched media. Stream waters were found to be domianted by Pseudomonas spp. and groundwaters were dominated by Bacillus spp. No differences were found in either numbers or species identified between tryptone - glucose - yeast extract agar, brain-heart infusion agar, nutrient agar, or casein - peptone - starch agar. It is concluded that the nalidixic acid method is the best suited for the enumeration of the bacteria in surface waters. A suitable method for determining viability in groundwater was not found. Different population structures were found in stream water and groundwater samples. (Lantz-PTT)
W86-05420

RECENT HEAVY PRECIPITATION IN THE VICINITY OF THE GREAT SALT LAKE: JUST HOW UNUSUAL,

National Climatic Center, Asheville, NC.
T. R. Karl, and P. J. Young.
Journal of Climate and Meteorology JCAMEJ, Vol. 25, No. 3, p 353-363, March 1986. 6 fig, 5 tab, 12 ref. DOE Interagency Agreement DE-A105-850R-21501.

Descriptors: *Great Salt Lake, *Areal precipitation, *Time series analysis, *Risk assessment, *Lake levels, Palmer drought severity index, Utah, Wet spells, Long-term planning.

A long time series (1863-1984) of areal precipitation in the vicinity of the Great Salt Lake (Utah) is shown to be highly correlated with Great Salt Lake levels. This time series is used to assess the unusual recent episode of heavy precipitation (1981 through 1984). The Palmer Drought severity Index is used to identify wet spells of weather. The cumulative excess precipitation during each wet spell was analyzed using stochastic frequency analysis. The analysis indicates that there were two very important wet spells in the time series, the first beginning and ending in the 1860s and the most recent, which began in late 1981. The analysis suggests that the recent heavy precipitation is not unexpected. Furthermore, if the climate of the past 122 yr is representative of the climate over the next 100 yr, another wet spell can be anticipated to be at least severe, in terms of excess precipitation, as the 1981-84 wet spell. Whether lake levels can recede to sufficiently low levels to prevent new record high levels during the next severe wet period is uncertain, but it must be considered in any long-term risk assessment strategies. (Author's Abstract)
W86-05550

PRACTICAL ESTIMATES OF LAKE EVAPORATION,

National Hydrology Research Inst., Ottawa (Ontario).
F. I. Morton.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 3, p 371-387, March 1986. 7 fig, 17 tab, 30 ref.

Descriptors: *Evaporation, *Lakes, *Potential evapotranspiration, *Areal Evapotranspiration, *Complementary relationship lake evaporation model, North America, East Africa, Mathematical Models, Climatic Data.

Practical estimates of lake evaporation must rely on data that can be observed in the land environment. This requires the ability to take into account the changes in the temperature and humidity that occur when the air passes from the land to the lake environment. The complementary relationship between potential and areal evapotranspiration provides such a capability, and is used in this paper, in combination with an approximated technique for taking into account subsurface heat storage changes, as the basis for formulating the complementary relationship lake evaporation (CRLE) model. Because it has a realistic basis, the CRLE model can utilize routine estimates of lake evaporation anywhere in the world with no need for locally calibrated coefficients. This potential is demonstrated here by comparing estimates of published water budget estimates for 16 lakes in North America with one lake in Easy Africa. (Author's Abstract)
W86-05551

TROPHIC STATUS OF 19 SUBARCTIC LAKES IN THE YUKON TERRITORY,

Department of Fisheries and Oceans, Vancouver (British Columbia). Fisheries Research Branch.
For primary bibliographic entry see Field 5C.
W86-05559

ACCUMULATION OF CADMIUM BY WHITE SUCKERS (CATOSTOMUS COMMERSONI) IN RELATION TO FISH GROWTH AND LAKE ACIDIFICATION,

Toronto Univ. (Ontario). Dept. of Zoology.
For primary bibliographic entry see Field 5B.
W86-05560

EVALUATION OF FACTORS RELATED TO THE UNUSUALLY LOW CHLOROPHYLL LEVELS IN PRAIRIE SALINE LAKES,

Alberta Univ., Edmonton. Dept. of Zoology.
C. E. Campbell, and E. E. Prepas.
Canadian Journal of Fisheries and Aquatic Science CJFSBX, Vol. 43, No. 3, p 846-854, March 1986. 1 fig, 5 tab, 70 ref.

Descriptors: *Prairie saline lakes, *Chlorophyll A, *Alberta, *Periphyton, *Nitrogen, *Phosphorous, *Total dissolved solids, Phytoplankton, Biomass, Primary productivity, Empirical models, Zooplankton, Bacteria, Bioassays, Detritus, Canada.

Prairie saline lakes in Canada have remarkably low chlorophyll a (Chl a) levels relative to total phosphorous (TP) and total nitrogen (TN) levels. To evaluate factors related to low Chl a levels, three Alberta saline lakes (total dissolved solids > 5 g/l) were studied in 1983 and 1984. Mean summer phytoplankton Chl a ranged from 3 to 10 micrograms/liter; mean summer periphyton Chl a was less than 70 mg/sq m. whereas mean summer TP and TN ranged from 2 to 13 and from 4 to 11 mg/liter, respectively. Chl a and phytoplankton primary production were extremely low relative to predictions from measured TP and TN levels and empirical models for freshwaters. Bioassays indicated that inorganic phosphorous was not limiting, whereas ionrganic nitrogen was limiting algal growth. Bacterial densities and zooplankton dry weight were high (>10(7) cells/ml and >1.0 mg/liter, respectively) relative to predictions from Chl a and empirical models for freshwaters. Phytoplankton biomass was insufficient to maintain the zooplankton populations; bacteria and detrius were likely a major food source for zooplankton. This study suggests that freshwater models are not applicable to prairie saline lakes. (Author's Abstract)
W86-05562

TRANSPORT OF 60CO BETWEEN WATER AND SEDIMENTS IN A SMALL SHIELD LAKE,

Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 5B.
W86-05563

LARGE-SCALE RISK ASSESSMENT OF ACID RAIN IMPACTS ON FISHERIES: MODELS AND LESSONS,

Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W86-05565

RESPONSES BY BENTHIC MACROINVERTEBRATES TO PROLONGED FLOODING OF MARSH HABITAT,

Delta Waterfowl and Wetlands Research Station, Portage la Prairie (Manitoba).
H. R. Murkin, and J. A. Kadlec.
Canadian Journal of Zoology CJZOAG, Vol. 64, No. 1, p 65-72, January 1986. 4 fig, 2 tab, 41 ref.

Descriptors: *Benthic fauna, *Macroinvertebrates, *Marshes, *Manitoba, *Flooding, *Vegetation, Canada, Cattails, Biomass, Diversity, Density, Cover types, Litter, Decomposing organic matter, Herbivores, Detritivores.

The seasonal differences in benthic invertebrate densities and biomass within the dominant vegetation types were examined in a series of 5-ha experimental marshes in south central Manitoba (Canada). Following periods of normal water depths, the marshes were flooded to 1 m above the existing cattail beds for up to 2 yr to determine the benthic invertebrate response to prolonged above-normal flooding densities and biomass were low during periods of normal water depths when compared with levels during later flooding. The benthic response to flooding was primarily within the herbivore-detrivore group, especially non-predaceous chironomids. All cover types other than former open-water sites showed increases in benthos densities, biomass, and numbers of taxa following flooding. The increases following flooding appear to be related to the death of the below-ground components of the emergent vegetation, the availability of coarse organic litter early in flooding, and the development of fine particulate organic matter during flooding. (Author's Abstract)
W86-05567

MICROBE-MEDIATED EFFECTS OF LOW PH ON AVAILABILITY OF DETRITAL ENERGY TO A SHREDDER, CLISTORONIA MAGNIFICA (TRICHOPTERA: LIMNEPHILIDAE),

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.
K. van Frankenhuyzen, and G. H. Geen.
Canadian Journal of Zoology CJZOAG, Vol. 64, No. 2, p 421-426, February 1986. 4 fig, 4 tab, 29 ref.

Descriptors: *Clistoronia magnifica, *Acid rain, Shredders, *Hydrogen ion concentration, *Decomposing organic matter, *Fungi, *Bacteria, *Detritus, Radioisotopes, Alder leaves, Caddisfly larva, Growth, Enzymes.

The authors tested the hypothesis that microbe-mediated changes in nutritional quality of leaf litter conditioned at low pH enhanced larval growth of the caddisfly shredder Clistoronia magnifica. Alder leaves conditioned for more than 3 wk at pH 4 had greater fungal biomass and bacterial abundance than leaves conditioned at pH 6. Differential microbial colonization did not affect ingestion rates. Radioisotope experiments indicated that late-instar larvae assimilated microbe-derived energy from leaves conditioned at pH 4 with a 10-15% higher efficiency than microbial energy from leaves conditioned at pH 6 and suggested a concomitant 5% increase in assimilation of leaf-derived energy. Enhanced growth of C magnifica at low pH could be accounted for by increased fungal biomass on leaves conditioned at low pH and increased availability of leaf energy, presumably due to additional modification of the leaf substrate by fungal enzymes. (Author's Abstract)
W86-05568

KINETIC MODEL OF ALGAL GROWTH INCORPORATING INTRACELLULAR CARBOHYDRATE AND PHOSPHORUS POOLS,

Kyoto Univ. (Japan). Dept. of Environmental and Sanitary Engineering.
H. Tsuno, and T. Goda.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 1/2, p 39-57, June 1985.

Descriptors: *Photosynthesis, *Nutrients, *Algal growth, *Chlorella, *Growth kinetics, Mathematical model, Algal physiology, Carbohydrates, Phosphorus, Metabolism, Simulation.

A series of studies were conducted on a kinetic model of photosynthesis, nutrient ingestion, and metabolism for algal growth. Coefficients included in the proposed model were examined with reference to experimental data on growth of Chlorella sp. It is shown that the proposed model can simulate the metabolism of algal growth, change of intracellular phosphorus content, and effects of nutrients on algal growth. (Author's abstract)
W86-05583

HYPERTROPHY, A CONSEQUENCE OF DEVELOPMENT,

National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5C.
W86-05590

QUANTITATIVE IMPORTANCE OF ALKALINITY FLUX FROM THE SEDIMENTS OF ACID LAKES,

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W86-05599

DISTRICT-WIDE WATER RESOURCES INVESTIGATION AND MANAGEMENT USING LANDSAT DATA, PHASE 1: LAKE VOLUME,

Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
For primary bibliographic entry see Field 7B.
W86-05744

KERR RESERVOIR LANDSAT EXPERIMENT ANALYSIS FOR MARCH L98L,

Kentron International, Inc., Hampton, VA. Technical Center.
For primary bibliographic entry see Field 5A.
W86-05746

WATER MOVEMENT IN MIRELANDS,

Leningrad State Univ. (USSR). Faculty of Geography.
K. E. Ivanov.
Academic Press, London, England. 1981. Translated by Arthur Thomson and H. A. P. Ingram. 276 p.

Descriptors: *Peat bogs, *Mirelands, *Groundwater movement, Ecosystems, Bogs, Hydrodynamics, Water exchange, Land reclamation, Vegetation, Waterlogging, Soviet Union.

This is the first treatise appearing in the English language to deal with the general hydrology of peatlands. Its significance stems first from the unique character of peatland hydrology and the central role played by water relations in the establishment and maintenance of peatlands and; second, from the great importance of peatlands as objects of ecological, geophysical and geographical enquiry, as natural resources in their own right and as areas whose peculiar hydrological characteristics present a formidable challenge to agriculture, civil engineering, land management and conservation. The course of development of peatlands depends upon the climate and morphology of the site. Mires in depressions grow differently from those in interfluves because their water supply undergoes a different sequence of changes. From this arises a system of peatland classification which combines the stratigraphy of the peat deposit with the characteristics of its present vegetation, soil and hydrology. Thus it is shown how, at every stage of development, differences in groundwater flow are responsible for differentiating the soil-physical characteristics and associated vegetation types within a mire ecosystem, and enables them to form an integrated pattern so that each ecosystem behaves as a functional unit in peatland terrain. Although elements of this approach are widely accepted in the West, no general quantitative analysis based upon it has as yet been undertaken outside the Soviet Union. The author here demonstrates the use of such analysis in evaluating the effect of climate on peatlands, in the general ecological study of peatlands, and in the survey of peatlands by air photogrammetry, using it to identify mechanisms that make for stability in peatlands, especially in those widely misunderstood mire ecosystems which contain pools or lakes. (Lantz-PTT)
W86-05801

SHORELINE REVEGETATION STUDIES AT LAKE TEXOMA ON THE RED RIVER, TEXAS-OKLAHOMA,

Southeastern Oklahoma State Univ., Durant. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2I.
W86-05805

PHYSICAL MODELING OF RESERVOIR HYDRODYNAMICS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2A.
W86-05806

SKILL TESTS AND PARAMETRIC STATISTICS FOR MODEL EVALUATION,

Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W86-05817

CONTINUOUS MEASUREMENT OF ALGAE BIOMASS BY MEANS OF CHLOROPHYLL FLUORESCENCE IN MONITORING STATIONS IN LOWER SAXONY,

Niedersaechsischen fuer Wasserwirtschaft, Hildesheim (Germany, F.R.).
U. Noack, N. Herden, J. Loffler, C. Warcup, and M. Gorsler.
Zeitschrift fuer Wasser -und Abwasserforschung ZWABAQ, Vol. 18, No. 4, p 177-182, August 1985. 7 fig, 10 ref.

Descriptors: *Algae, *Biomass, *Eutrophication, *Chlorophyll a, *Fluorescence, Lakes, Reservoirs, Surface water, Rivers, West Germany, Lower Saxony, Lake Druemmer, Weser River, Herbicides, Diurnal distribution, Annual distribution.

Assessment of the ecological state and the ecotrophical metabolism of lakes, reservoirs and slowly flowing rivers requires biological methods which evaluate the primary producers, the algae. The biomass of living algae can be estimated by its chlorophyll a content. The degree of trophication is therefore reflected by the quantity of chlorophyll a. Measurement of the in vivo chlorophyll fluorescence provides a reliable method of evaluating the development of the algae biomass. Preliminary tests on the polytrophic shallow lake Duemmer (Lower Saxony) resulted in a linear correlation between chlorophyll a content and defined fluorescence yield after treatment with an herbicide (CMU). By means of an automatic fluorometer with continuous measurement capability it is possible to follow and document diurnal and annual algae fluctuations and the actual productivity of the living cells at the point of water sampling (in situ). At present such fluorometers are installed in monitoring stations on the river Weser (Drakenburg) and on the shallow lake Duemmer (Seemitte). (Master-PTT)
W86-05819

POSSIBILITIES OF USING THE SP-403/5 ECHOSOUNDER TO INVESTIGATE THE THICKNESS OF LAKE BOTTOM SEDIMENTS,

Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Inst. of Hydrobiolgy and Water Conservation.
M. Rybak.
Acta Hydrobiologica, Vol. 27, No. 1, p 17-24, 1985. 2 fig, 1 tab, 23 ref.

Descriptors: *Echosounders, *Bottom sediments, *Lake sediments, Lakes, Sediments, Lake Kortowo, Measuring equipment, Sonar, Poland, Slopes, Sound waves, Seston, Erosion, Sand, Gravel, Loam.

The usefulness of the SP-403/5 echosounder for investigation of the thickness of lake bottom sediments was estimated. The investigation was carried out on Lake Kortowo, Poland. Two sections were made and echograms with distinctly marked sediment thicknesses were obtained. The obtained echograms allow a preliminary estimation of the displacement of sediments in the lake. Attention should be paid to the fact that the shape of the lake bottom on the echograms may be distorted in relation to reality, particularly the angle of inclination of the underwater slope. Numerous factors may limit the ultrasonic wave course, both in water and in the lake sediments themselves, when using an echosounder. These factors include: seston floating on the water (for instance a mass appearance of phytoplankton), or a displacement in the sediment stratigraphy caused by erosive interbedding of sand, loam, or gravel. In order to confirm the credibility of the echograms as well as their proper analysis, several borings with a Douglas drill were made. (Doria-PTT)
W86-05890

MACROINVERTEBRATE DRIFT IN THE MIDDLE COURSE OF THE RIVER DUNAJEC (SOUTHERN POLAND),

Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
T. Fleituch.
Acta Hydrobiologica, Vol. 27, No. 1, p 49-61, 1985. 4 fig, 4 tab, 25 ref.

Descriptors: *Macroinvertebrates, *Dunajec River, *Poland, *Drift, Ecological distribution, Population density, Seasonal variations, Photoaxis, Macrofauna, Benthos.

The diel activity of macroinvertebrate drift in the middle course of the Dunajec River, Poland, in certain months during the years 1980-81, was investigated. Studies on diel changes in drift composition and intensity, indicate that in most groups of river macrofauna, even in different climatic zones, there is intensified night activity. In the River Dunajec, drift density also increased during the night, with the exception of Chironomidae, which drifted aperiodically. There was an intensified drifting of macrofauna in the River Dunajec in summer months, caused by the shortened night. Sunshine inhibits the drifting of animals (negative phototaxis) but the effect of moonlight is controversial. Some authors have found an inhibiting effect of moonlight on the detachment of orga-

nisms from the substratum, but this dependence was not established in the Dunajec. The lack of any significant dependence between drift and benthos density established in the present work is in accordance with results obtained in other studies. However, significant correlations were found between drift and benthos, though only for some taxonomic groups. For most species, this dependence appears to be non-significant. (Doria-PTT)
W86-05891

DENSITY, BIOMASS, AND RESPIRATION OF PHYTOPHILOUS MACROFAUNA OF ASSOCIATIONS OF POTAMOGETON PERFOLIATUS L. OF A POLYMICTIC, EUTROPHIC LAKE,

Department of Environmental Protection, Poznan (Poland).
For primary bibliographic entry see Field 5C.
W86-05892

GEOCHEMICAL CONTROL OF (H+) IN LAKES RECEIVING ACIDIC DEPOSITION,

Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
S. D. Faust, and R. Schmidt.
Journal of Environmental Science and Health JESEDU, Vol. A20, No. 6, p 599-616, August 1985. 3 tab, 22 ref.

Descriptors: *Geochemistry, *Hydrogen ion concentration, *Lakes, *Acid rain, *Water pollution treatment, Chemical properties, Acidity, Catfish pond, New Jersey, Fate of pollutants, Lake sediments, Chlorite, Ilfite, Kaolinite, Vermiculite, Quartz, Ion exchange, Model studies.

Seven fresh water lakes in northern New Jersey have been studied for their reaction to acidic deposition. One lake, Catfish Pond, has been acidic for at least four years (pH 4.58-5.64), while the other six lakes have pH values in the 6.0 to 10.0 range. The following aluminosilicates were detected in bottom sediments from these lakes: chlorite, illite, kaolinite, and possibly vermiculite, as well as quartz. It was postulated that ion exchange and acidic dissolution are the dominant factors controlling (H+) in the waters. Consequently, nine geochemical weathering models were written and examined for their ability to predict pH values in agreement with measured values. Excellent agreement was obtained from muscovite-gibbsite-kaolinite models for pHcal with pHlab. For Catfish Pond, dissolution models of muscovite and kaolinite also gave excellent agreement. Therefore, it appears that bottom sediments of lakes serve as acidic 'sinks' and neutralize overlying waters. This also suggests a technique for renovation of acidified lakes, whereby aluminosilicates could be added so that their weathering reactions might maintain neutral pH values. In Catfish Pond, weathering may have proceeded beyond the ion exchange reaction to the dissolution of the sediments. (Doria-PTT)
W86-05903

SURFACE WATER CHEMISTRY IN THE ILWAS BASINS,

Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
For primary bibliographic entry see Field 5B.
W86-05907

ILWAS MODEL: FORMULATION AND APPLICATION,

Tetra Tech, Inc., Lafayette, CA.
For primary bibliographic entry see Field 2K.
W86-05908

CHLORIDE BUDGET FOR ONONDAGA LAKE, NEW YORK, U.S.A.,

Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, and C. T. Driscoll.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 1-2, p 29-44, January 1986. 8 fig, 1 tab, 23 ref.

Descriptors: *Path of pollutants, *Chlorides, *Onondaga Lake, *Chemical analysis, Lakes, Water chemistry, New York, Alkalinity, Pollution load.

A Cl budget is presented for a 12 yr period (1970-1981) for Cl enriched (approximate volume-weighted average concentration of 1500 mg Cl per liter) Onondaga Lake, New York. The budget utilizes continuous discharge and lake and stream water chemistry data, collected at approximately 2 week intervals, over the 12 yr study period. Budget calculations were supplemented by high frequency water chemistry data from the lae and the tributary carrying the major portion of the loading. More than 85% of the external load of Cl (approximately 9 x 10 to the 8th power kg/year) to the lake originates from an alkali manufacturer. Export of Cl from the lake was highly correlated to outflow from the lake ($R = 0.915$, for a resolution of 1 mo). A good balance between estimated external loads and lake export was obtained (within 7%) for the 12 yr period, indicating that lake concentrations are consistent with external loading of this conservative substance. The results of this analysis contradict previous calculations that indicated 40 to 50% of the Cl in the lake originated from natural internal sources. (Doria-PTT)
W86-05912

LIFE CYCLES OF HYDROPSYCHE RIOLA, H. SLOSSONAE AND CHEUMATOPSYCHE PETTITI (TRICHOPTERA: HYDROPSYCHIDAE) IN A SPRING-FED STREAM IN MINNESOTA,

Toronto Univ. (Ontario). Dept. of Zoology.
R. J. Mackay.
The American Midland Naturalist, Vol. 115, No. 1, p 19-24, January 1986. 2 fig, 30 ref.

Descriptors: *Aquatic insects, *Hydropsychids, *Caddisflies, *Minnesota, *Life cycles, Streams, Springs, Stream biota, Aquatic life, Insects, Life history studies, Temperature effects.

Life cycles were studied for hydropsychid populations downstream of a small (0.06 ha) impoundment in a Minnesota trout stream where headwater springs maintained water temperatures between 2 and 16 C in 1981-1983. Hydropsyche slossonae Banks and Cheumatopsyche pettiti (Banks) were both univoltine with a long period of summer recruitment beginning in late June. They both overwintered mainly in the third and fourth instars and began to pupate the following May. Hydropsyche riola Denning hatched one to two weeks earlier and grew more rapidly in summer than the other species; some individuals matured within two months and may have produced a small second generation. Most of the H. riola population overwintered in the final instar and began pupating the following April. The largely northern distribution of H. riola may have adapted it to such cool temperatures that the Valley Creek temperatures were relatively warm enough, especially in winter and early spring, to promote faster growth than usually is seen in North American species of Hydropsyche at equivalent temperatures. (Doria-PTT)
W86-05930

PREDATOR SPECIES RICHNESS AND PREY POPULATION VARIABILITY: EFFECTS ON DIETS OF BENTHIC STREAM FISHES,

Wisconsin Dept. of Natural Resources, Madison. Bureau of Fish Management.
M. J. Hansen, S. P. Gloss, and B. L. Peckarsky.
American Midland Naturalist, Vol. 115, No. 1, p 63-72, January 1986. 2 fig, 4 tab, 35 ref.

Descriptors: *Species diversity, *Predation, *Population dynamics, *Fish, Benthic fauna, Aquatic populations, Ecology, Benthic environment, Ohio River Basin, Invertebrates, Distribution patterns, Temporal distribution, Spatial distribution.

The feeding ecology of benthic fishes was examined in a low-gradient warm-water stream in the upper Ohio River basin to determine (1) the degree of dietary similarity among predaceous fishes; (2) the dietary response of fishes to variable prey abundance (temporal and spatial); and (3) the dietary response of fishes to varying numbers of potential interspecific competitors. Eight fish species were sampled along with their associated potential benthic invertebrate prey complex at nine riffle stations along a longitudinal gradient in French Creek, New York on seven biweekly dates during summer 1980. The distribution pattern of fishes was longitudinal; species additions occurred at successive downstream sampling stations. The density of the benthic macroinvertebrate prey complex varied more through time than space due to a midsummer peak in invertebrate populations. However, diversity varied more through space than time due to a direct correspondence with longitudinal position and with predator diversity. Predaceous benthic fishes gave no evidence of resource partitioning by prey type either during the period of lowest prey densities or because of increased numbers of potential competitors. Instead, they had the greatest diet breadth when prey densities were highest. (Doria-PTT)
W86-05932

HISTORY OF DRAINAGE AT WICKEN FEN, CAMBRIDGESHIRE, ENGLAND, AND ITS RELEVANCE TO CONSERVATION,

Cambridge Univ. (England). Dept. of Applied Biology.
T. A. Rowell.
Biological Conservation, Vol. 35, No. 2, p 111-142, March 1986. 4 fig, 2 tab, 71 ref.

Descriptors: *Drainage, *Wicken Fen, *Cambridgeshire, England, *Conservation, *Fens, Ecology, Species diversity, Habitats, Environment, Water table decline, Water table, Wetlands, Drainage effects.

Wicken Sedge Fen is a wetland reserve that has suffered a lowered water table in recent years. This has been cited as responsible for a subsequent loss of typical plant species, the contraction of typical plant communities, and an influx of some new species. However, the drainage regime has been extremely variable in the past as a result of drainage activity involving the piecemeal draining of nearby land, and cycles of failure, reinstatement, and occasional improvement of drainage structures. Efficient modern drainage destroyed these cycles and permanently lowered the water table. While the lowered water table can be implicated in some ecological changes at Wicken Fen, other factors, notably the mowing regime, also have been important. It is suggested that all desirable plant communities could be maintained or created at Wicken by partitioning the site, manipulating the water table locally, and maintaining traditional management where appropriate. (Doria-PTT)
W86-05934

TAXONOMY OF SYNURA (CHRYSOPHYCEAE) IN ONTARIO WITH SPECIAL REFERENCE TO TASTE AND ODOR IN WATER SUPPLIES,

Ontario Ministry of the Environment, Rexdale. Water Resources Branch.
For primary bibliographic entry see Field 5A.
W86-05936

EFFECTS OF DISTURBANCE ON MARSH SEED BANKS,

Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2I.
W86-05937

MIXED-LAYER DEEPENING IN LAKES AFTER WIND SETUP,

Technische Hogeschool Delft (Netherlands). Lab. of Fluid Mechanics.
C. Kranenburg.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 9, p 1279-1297, September 1985, 9 fig, 4 tab, 13 ref, append.

Descriptors: *Lakes, *Wind tides, *Mixed layers, Surges, Wind flume, Wind shear, Velocity, Entrainment.

Laboratory experiments on wind-driven mixed-layer deepening in a wind flume are described for the situation where the wind shear stress has

become balanced by a streamwise pressure gradient so that the mean mixed-layer velocity has vanished. The results were obtained at two lengths of the flume, and include visual observations, entrainment rates, density profiles, velocity profiles, and profiles of turbulence intensities. An intermediate upwind wedge formed by accumulation of mixed water was observed in all experiments. The entrainment law obtained agrees with Kraus and Turner's relationship, and is almost independent of the length of the flume. The distributions of mean velocity and turbulence intensities in the mixed layer are similar to those in a turbulent bouindary layer along a flat plate. (McFarlane-PTT)
W86-05967

TURBITY CURRENT WITH EROSION AND DEPOSITION,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 2J.
W86-05982

PRELIMINARY INVESTIGATION OF PRIMARY PRODUCTION AND DECOMPOSITION IN FOUR PEATLANDS NEAR SCHEFFERVILLE, QUEBEC,

McGill Univ., Montreal (Quebec). Dept. of Geography.
I. Bartsch, and T. R. Moore.
Canadian Journal of Botany CJBOAW, Vol. 63, No. 7, p 1241-1248, July 1985, 1 fig, 8 tab, 41 ref.

Descriptors: *Peat Bogs, *Primary Productivity, *Decomposition, Conductivity, Hydrogen ion concentration, Topography, Climates, Fens, Nutrients, Chemical properties.

Peatlands are common features of temperature and boreal regions of the northern hemisphere. Rates of peat accumulation are determined by the ratio between production and decomposition, and the interactive effects of climate, topography, and nutrient supply on these processes. Peat accumulation is the result of retarded decomposition, rather than rapid productivity. The water chemistry and ecological type of four peatland sites were related: low pH and conductivity = poor fen, intermediate pH and moderate conductivity = transitional fen, intermediate pH and conductivity = rich fen, and neutral pH and high conductivity = extremely rich fen. (McFarlane-PTT)
W86-06003

SUCCESSION AND BIOMASS ALLOCATION AS CONTROLLED BY SPHAGNUM IN AN ALASKAN PEATLAND,

Duke Univ., Durham, NC. Dept. of Botany.
J. O. Luken, W. D. Billings, and K. M. Peterson.
Canadian Journal of Botany CJBOAW, Vol. 63, No. 9, p. 1500-1507, September 1985, 2 fig, 6 tab, 36 ref.

Descriptors: *Peat Bogs, *Succession, *Alaska, *Biomass, Permafrost, Climates, Primary productivity, Sphagnum.

In peat bogs underlain by permafrost, succession can occur simultaneously on two major scales. A microsuccession can be identified among Sphagnum hummock-hollow complexes, and a macrosuccession can occur as a result of changes in climate or geomorphic processes associated with permafrost melting and formation. In general, areas with standing water are free of permafrost. Comparison of a bog forest (Picea) with an Andromeda bog indicates that 1) the Andromeda bog is wetter than the bog forest, 2) the bog forest has a more diverse flora, 3) both above- and below-ground vascular plant biomass was higher in the bog forest. Total aboveground net primary production of the shrub and herb layer in the bog forest and the Andromeda bog was 74.2 and 52.8 gm/sq m/yr, resp. (McFarlane-PTT)
W86-06004

EFFECTS OF SALINITY ON PREFERRED AND LETHAL TEMPERATURES OF THE MOZAMBIQUE TILAPIA, OREOCHROMIS MOSSAMBICUS (PETERS),

Pennsylvania State Univ., University Park. Dept. of Fishery Science.
For primary bibliographic entry see Field 5C.
W86-06014

VARIABILITY IN THERMAL STRATIFICATION IN A RESERVOIR,

Upstate Freshwater Inst., Inc., Syracuse, NY.
E. M. Owens, S. W. Effler, and F. Trama.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 219-227, April 1986. 4 fig, 3 tab, 21 ref.

Descriptors: *Thermal stratification, *Reservoir operation, *Light penetration, *Weather, Epilimnion, Metalimnion, Hypolimnion, Vertical mixing, Flow-augmentation reservoir, Round Valley Reservoir, New Jersey, Mathematical analysis.

The thermal stratification characteristics of a flow-augmentation reservoir, Round Valley Reservoir, New Jersey, and attendant driving conditions were documented and analyzed for portions of 3 yr. Substantial differences in the thermal stratification regime of the reservoir occurred in response to the documented changes in meteorological, operating, and light penetration conditions. The features of stratification that were affected included: the depth of the upper mixed layer, the average temperature of the epilimnion, the temperature gradient in the metalimnion, and the average temperature in the hypolimnion. (Author's abstract)
W86-06016

COMPARISON OF FOUR ARTIFICIAL SUBSTRATES AND THE PONAR GRAB FOR BENTHIC INVERTEBRATE COLLECTION,

Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 7B.
W86-06018

MULTIVARIATE ANALYSIS OF PROTIST COMMUNITIES IN LENTIC SYSTEMS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
P. M. Stewart, E. P. Smith, J. R. Pratt, P. V. McCormick, and J. Cairns, Jr.
Journal of Protozoology JPROAR, Vol. 33, No. 2, p 152-156, May 1986. 5 fig, 6 tab, 34 ref.

Descriptors: *Protists, *Artificial substrates, *Trophic states, *Hydrogen ion concentration, *Oxygen, *Nutrients, *Orthophosphates, *Silica, Conductivity, Multivariate analysis, Limnology, Physiocochemical properties, Alkalinity, Chlorides, Temperature, Ammonia, Phosphate, Principal component analysis, Douglas Lake, Lake Munro, Walloon Lake, Bryants Bog, Cheboygan Marsh, Michigan, Species diversity.

The roles of physico-chemical parameters in structuring protist communities that colonize polyurethane foam artificial substrates were studied in summer 1983. Habitats in which the substrates were placed covered a wide range of trophic states; they were Douglas Lake, Lake Munro, Walloon Lake, Bryant's Bog, and Cheboygan Marsh, all in northern lower Michigan. Triplicate artificial substrates were sampled after 1, 3, 7, 14, 21, and 42 days of exposure. During this study, 90 living protist samples were examined for the number of kinds of species. Water samples were analyzed for pH, conductivity, alkalinity, chloride, silica, temperature, dissolved oxygen, ammonia, and total and ortho-phosphate concurrent with artificial substrate collections. A total of 546 protist species were recorded, but only 7 species were found in over 50% of the samples and 121 species were found in only one sample. The 96 most common species were examined in relation to environmental parameters using several multivariate statistical procedures. Factor analysis (principal components with varimax rotation) performed on the total environmental data set showed tha three composite factors explained 85% of the variability in the data set. A reciprocal averaging ordination (RAO) was used to reduce species presence/absence data and to separate samples graphically by their species composition. Significant correlations, with RAO-generated axes from all five systems, were found with pH, oxygen, and a nutrient factor to axis 1. Factor analysis on the physico-chemical parameters of the three lakes showed that three factors explained 71% of the environmental data set variability. The RAO-generated axis (axis 1) was correlated with silica ortho-phosphate, and Factor 2, which was primarily comprised of loadings from ortho-phosphate. These techniques support the hypothesis that a limited number of environmental parameters strongly affect protist community composition. (Author's abstract)
W86-06028

OXYGEN PERCEPTION AND O_2 TOXICITY IN THE FRESHWATER CILIATED PROTOZOAN LOXODES,

Freshwater Biological Association, Ambleside (England).
B. J. Finlay, T. Fenchel, and S. Gardener.
Journal of Protozoology JPROAR, Vol. 33, No. 2, p 157-165, May 1986. 9 fig, 2 tab, 46 ref.

Descriptors: *Dissolved oxygen, *Limnology, *Loxodes, *Animal behavior, *Cytochrome oxidase, Toxicity, Hydrogen ion concentration, Carbon dioxide, Sulfide, Spatial distribution, Cyanide, Sodium azide, Rotenone, Antimycin A, Superoxide dismutase, Enzymes, Mortality, Reproduction, 2,4-Dinitrophenol, 2-Heptyl-4-hydroxyquinoline-N-oxide, Esthwaite Water, Priest Pot, England.

Loxodes reached peak abundance close to the oxic-anoxic boundary in (02 > or = 5% atmosphere) in two lakes (Esthwaite Water and Priest Pot, United Kingdom), in test tube cultures, and in glass chambers with horizontal 02 gradients. Vertical profiles of CO_2, pH, sulfide, and Fe^{2+} in a lake were not closely related to Loxodes abundance. In a laboratory experiment, Loxodes followed a retreating source of 02 and was repelled by high p02. This behavior was sustained when cells simultaneously swam up or down gradients of both CO_2 and pH. Aggregation of cells was abolished by KCN (0.0001 to 0.000006 M). Sodium azide (0.1 to 0.0001 M) had no effect, and 2,4-dinitrophenol sharpened the aggregation. Rotenone, Antimycin A, and 2-heptyl-4-hydroxy-quinoline-N-oxide had no obvious effect. Cytochrome oxidase is probably the oxygen receptor. Loxodes striatus contained low activities of superoxide dismutase and catalase. Extracellular production of superoxide and hydrogen peroxide were probably not responsible for the exclusion of Loxodes from water with a high p02. Continuous exposure of Loxodes to oxygen at normal atmospheric pressure at 10 C led to 50% mortality in 10 days. Cells left free to swim in an oxygen gradient doubled their number in the same period. Light exacerbated the toxic effects of 02. Behavioral responses to the dissolved oxygen tension probably controlled the spatial distribution of Loxodes. (Author's abstract)
W86-06029

STATISTICAL ANALYSIS OF HEAVY METAL CONCENTRATIONS FROM LAKE SEDIMENTS,

Texas A and M Univ., College Station. Center for Trace Characterization.
For primary bibliographic entry see Field 5B.
W86-06088

INTEGRATED LAKE-WATERSHED ACIDIFICATION STUDY: SUMMARY,

Electric Power Research Inst., Palo Alto, CA. Environmental Assessment Dept.
For primary bibliographic entry see Field 5B.
W86-06092

INTEGRATED LAKE-WATERSHED ACIDIFICATION STUDY: ATMOSPHERIC INPUTS,

Oklahoma State Univ., Stillwater. School of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W86-06093

BIOGEOCHEMICAL INFLUENCE OF VEGETATION AND SOILS IN THE ILWAS WATERSHEDS,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 5B.
W86-06094

MORPHOMETRIC VARIATIONS OF FIVE TIDAL MARSH HALOPHYTES ALONG ENVIRONMENTAL GRADIENTS,
Delaware Univ., Lewes. Coll. of Marine Studies.
D. M. Seliskar.
American Journal of Botany AJBOAA, Vol. 72, No. 8, p 1340-1352, August, 1985. 41 ref.

Descriptors: *Plant morphology, *Tidal marshes, *Halophytes, *Boundaries, *Wetlands, Soil water, Soil chemistry, Soil-water-plant relationships. Oregon.

Morphological characteristics of Deschampsia cespitosa, Grindelia integrifolia, Distichlis spicata, Jaumea carnosa, and Salicornia virginica varied significantly along transects between upper and lower portions of an Oregon salt marsh. The quantity of aerenchymatous tissue in S. virginica was greatest at the lower, wetter end of the transect. Reproductive effort was greatest at the upper distributional limit of G. integrifolia and D. spicata while greatest in J. carnosa at its lower limit. Soil moisture and soil chemical dtat were collected to relate morphometric variation to environmental parameters. Differences in plant structure may have applications as an aid in determining wetland boundaries. It is suggested that the evaluation of structural response could be useful to those responsible for setting wetland boundaries by indicating natural breaks along a continuum. (Alexander-PTT)
W86-06097

LOSS AND UPTAKE OF 15N-AMMONIUM IN SUBMERGED SOILS OF A CATTAIL MARSH,
Minnesota Univ., St. Paul. Dept. of Botany.
J. V. Dean, and D. D. Biesboer.
American Journal of Botany AJBOAA, Vol. 72, No. 8, p 1197-1203, August, 1985. 1 fig, 2 tab, 30 ref.

Descriptors: *Nitrification, *Denitrification, *Marshes, *Oxidation-reduction potential, *Cattails, Soil-water-plant relationships.

A study of uptake, distribution, and recovery of nitrogen by field populations of Typha latifolia L. (cattails) using (15NH4)2SO4 showed that 75-3% (53.6% in the plant and 21.7% in the soil) of the isotopically labeled nitrogen added to sampling cylinders containing a single cattail plant could be recovered at the end of one growing season, whereas only 34.6% could be recovered from control cylinders. The increased recovery of 15NH4(+)-nitrogen in cylinders containing actively growing T. latifolia compared to cylinders not containing plants suggests that T. latifolia rapidly assimilates labeled nitrogen before it is lost via denitrification or uptake by free-living soil mechanisms. Measurements of redox potentials in a 60-cm-deep field core planted or not planted with T. latifolia showed that only the top 2 and 5 cm of the water column was oxidized (> 200 mv at pH 7), respectively. The remaining 58 and 55 cm of the column, including the soil-water interface, was reduced (< 200 mv at pH7). The presence or absence of actively growing T. latifolia plants in the soil cores did not appear to alter significantly the redox profile. The presence of an oxidized zone overlying a reduced zone in cores collected from the field indicates that a portion of the 15NH4+-nitrogen added to cylinders during the field experiment may have been lost through nitrification-dentrification reactions. (Author's indicate)
W86-06098

AUTOMATIC METHOD FOR ON-LINE ESTIMATION OF THE PHOTOSYNTHETIC RATE IN OPEN ALGAL PONDS,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Electrical and Computer Engineering.
S. Ben-Yaakov, H. Guterman, A. Vonshak, and A. Richmond.
Biotechnology and Bioengineering BIBIAU, Vol. 27, No. 8, p 1136-1145, February 1986. 5 fig, 1 tab, 22 ref.

Descriptors: *Computer programs, *Automation, *Photosynthesis, *Algal ponds, Algal growth, Algal control, Computer models, Mathematical analysis, Dissolved oxygen.

An analytical model for measuring the dissolved oxygen concentration in an algal minipond was used to develop a new method for estimating online, the net oxygen production rate of the biological process. The method was tested experimentally and was found to provide crucial information on the vitality of the biological process, and an early warning of any possible forthcoming collapses of the ecosystem. The model and measurement method could provide investigators with useful tools for optimizing algal cultivation in the laboratories and plants. The method can easily be automated and is therefore useful for continuous monitoring, control operations and laboratory research, providing a tool for assessing on-line the general performance of the system. Integrating of this method into an optimization algorithm could markedly aid a search for optimal growth conditions of many photosynthetic organisms. This could eventually lead to the development of 'smart' controllers with a built-in ability to seek the most economical growth conditions. (Jones-PTT)
W86-06104

EXTRACELLULAR ORGANIC CARBON (EOC) RELEASED BY PHYTOPLANKTON AND BACTERIAL PRODUCTION,
Aarhus Univ. (Denmark). Botanical Inst.
M. Sondergaard, B. Riemann, and N. O. G. Jorgensen.
Oikos, Vol. 45, No. 3, p 323-332, December, 1985. 1 fig, 5 tab, 44 ref.

Descriptors: *Organic carbon, *Phytoplankton, *Bacteria, *Primary productivity, Aquatic productivity, Aquatic bacteria, Lakes, Coastal waters, Cycling nutrients, *Denmark, Radioactive tracus.

Parts of the pelagic carbon cycle were investigated during ten diel cycles in five Danish lakes and one coastal area. The study included simultaneous measurements of primary production, phytoplankton release and bacteria assimilation of extracellular organic carbon (EOC), bacterial production, and bacterial assimilation of dissolved free amino acids. The primary production, EOC release and assimilation were measured with the C14-method and particle size fractionation. The gross release of EOC ranged from 5 to 46% of the diel primary production and the major part of the released products were assimilated by bacteria. It was shown that diel time-course incubations should be used as opposed to short-time incubations. The bacterial production was estimated by two methods: the frequency of dividing cells (FDC) and H3-thymidine incorporation into DNA. An analysis based on primary production and amino acid assimilation in the freshwater samples showed that the FDC-method tended to overestimate the bacterial production, whereas the thymidine-method probably represented the true order of magnitude with a trend toward underestimation. In the lakes, the assimilation of EOC contributed substantially (>80%) to the bacterial production in three cases, moderately (38-50%) in three cases and was of less (<38%) importance in one case. Due to the presence of picophytoplankton (<1 micron) reliable results were not obtained at the coastal station. (Author's abstract)
W86-06141

EFFECT OF WATER LEVEL ON DESICCATION OF SPHAGNUM IN RELATION TO SURROUNDING SPHAGNA,
Uppsala Univ. (Sweden). Inst. of Ecological Botany.
For primary bibliographic entry see Field 2I.
W86-06142

EVIDENCE THAT FILTERABLE PHOSPHOROUS IS A SIGNIFICANT ATMOSPHERIC LINK IN THE PHOSPHOROUS CYCLE,
Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
W. M. Lewis, M. C. Grant, and S. K. Hamilton.
Oikos, Vol. 45, No. 3, p 428-432, December, 1985. 1 fig, 1 tab, 12 ref. Biomedical Research Support Grant No. RR 07012-16.

Descriptors: *Phosphorous, *Atmospheric deposition, *Cycling nutrients, Path of pollutants, Fate of pollutants, Watersheds, Water pollution sources, Nutrients, Lakes, Filtrate, Seasonal variation, Particulate matter, Organic matter, Phosphorous compounds, Pollen, Como Creek, Lake Dillon, Colorado.

The deposition of phosphorous (P) from the atmosphere was measured weekly over 7 annual cycles in the mountain region of Colorado at the Como Creek watershed and Lake Dillon. Deposition of P consistently reached a sharp peak in early summer, near the beginning of maximum biological activity. The peak was associated with soluble P capable of passing through a filter. Pollen studied showed that the peak was not accounted for by leaching of P from pollen, and the amounts of miscellaneous mineral and organic particulate materials did not account for the peak. Findings suggest that P is transported as a filterable, water-soluble substance, probably of biological origin, in large amounts over a short period of time. Such a transport mechanism may account for significant long-distance P transport. (Geiger-PTT)
W86-06143

2I. Water In Plants

SECONDARY PRODUCTION, EMERGENCE, AND EXPORT OF AQUATIC INSECTS OF A SONORAN DESERT STREAM,
Arizona State Univ., Tempe. Dept. of Zoology.
J. K. Jackson, and S. G. Fisher.
Ecology ECOLAR, Vol. 67, No. 3, p 629-638, June 1986. 6 tab, 2 fig, 74 ref.

Descriptors: *Aquatic insects, *Ecosystems, *Secondary productivity, Desert, Emergence, Export, Stream, Arizona, Sonora Desert.

Aquatic insect secondary production, emergence, and export of adults to the adjacent terrestrial ecosystem were assessed in Sycamore Creek, Arizona, by means of benthic sampling, emergence traps, and catch-nets that passively sampled adults falling into the stream. Sycamore Creek is an intermittent Sonoran Desert stream, 32 km northeast of Phoenix, Arizona. Secondary production and emergence were estimated for 7 groups of aquatic insects (Chironomidae, 14 species; Baetis quilleri Doods, Baetidae; Leptohypes packeri Allen, Tricorythidae; Tricorythodes dimorphus Allen, Tricorythidae; Helicopsyche mexicana banks, Helicopsychidae; Cheumatopsyche arizonensis, Ling, Hydropsychidae; Cryptolabis sp., Tipulidae.) Annual secondary production was 120.9 g/sq m/yr and emergence we 23.1 grams/sq m/yr (in dry mass units). The ratio of annual emergence to annual production varied among taxa and ranged from 2% to 29%. Chironomids comprised 48.2% of production and 59.7% of emergence and mayflies accounted for 45.9% and 19.2%, respectively. Approximately 3% of emergent insect biomass returned to the stream; thus 22.4 g/sq m/yr was transferred to the adjacent terrestrial ecosystem. The transfer of a significant portion of aquatic insect biomass to the terrestrial habitat reduced insects available to stream insectivores while providing prey for insectivores in neighboring terrestrial ecosystems. (Peters-PTT)
W86-05451

COMPARATIVE WATER-USE RATES AND EFFICIENCIES, LEAF DIFFUSIVE RESISTANCES, AND STOMATAL ACTION OF HEALTHY AND STRIPE-SMUTTED KENTUCKY BLUEGRASS,
Kansas State Univ., Manhattan. Dept. of Horticulture.

J. L. Nus, and C. F. Hodges.
Crop Science CRPSAY, Vol. 26, No. 2, p 321-324, March/April, 1986. 3 fig, 29 ref.

Descriptors: *Kentucky bluegrass, *Water stress. *Stomata, *Water-use rate, *Water-use efficiency, Leaf diffusive resistance, Light, Epidermis, Plant pathology, Osmosis, Transpiration, Leaves, Water Potentials, Grasses.

Kentucky bluegrass 'Merion' systemically infected by U striiformis (stripe smut) was compared in controlled-environment chambers with healthy plants for water-use rate (WUR) and efficiency (WUE), leaf diffusive resistance (LDR), and critical leaf-water potentials for stomatal closure. Leaves of infected plants with immature sori and no visible rupturing of the epidermis did not differ in WUR or WUE from healthy plants. Leaves of infected plants with mature sori with moderate to heavy sporulation and subsequent epidermal damage showed sharp decreases in WUR and WUE compared with healthy plants or infected leaves with immature sori and a visibly intact epidermis. No differences were observed in LDR between healthy and infected plants with mature or immature sori in the light. The LDR of infected plants in the dark was reduced only slightly by immature sori, but the presence of mature sori and subsequent epidermal rupturing lowered LDR to values similar to those exhibited by both healthy and infected plants in the light. Stomatal closure on infected leaves with immature sori occurred at lower leaf-water potentials than on healthy leaves, suggesting a degree of osmotic adjustment in response to pathogen-induced water stress. (Rochester-PTT)
W86-05508

RIVER RESEARCH GETS WASHED AWAY,

For primary bibliographic entry see Field 6G.
W86-05541

EFFECTS OF FLOODING AND SEDIMENTATION ON GERMINATION AND SURVIVAL OF LUDWIGIA LEPTOCARPA (NUTT.) HARA,

Georgia Univ., Athens.
For primary bibliographic entry see Field 5G.
W86-05804

SHORELINE REVEGETATION STUDIES AT LAKE TEXOMA ON THE RED RIVER, TEXAS-OKLAHOMA,

Southeastern Oklahoma State Univ., Durant. Dept. of Biological Sciences.
J. E. Lester, C. V. Klimas, H. H. Allen, and S. G. Shetron.
Final Report. Technical Report E-86-1, January 1986. 41 p, 17 fig, 5 tab, 1 append. Contract No. DACW56-79-C-0202.

Descriptors: *Revegetation, *Lake Texoma, *Red River, *Texas, *Oklahoma, Shoreline cover, Flooding, Plant growth, Arundo donax, Panicum virgatum, Salix nigra, Flood tolerance, Lakes, Reservoirs.

Three years of field studies were conducted at Lake Texoma on the Texas-Oklahoma border to evaluate the suitability of selected plant species for use in reservoir shoreline revegetation projects. The plants were subjected to various inundation treatments and were monitored for survival and growth. Two field sites were established: one on the shoreline of Lake Texoma, the other in a nearby small impoundment where water levels were controlled. Of 16 species tested, 11 demonstrated sufficient flood tolerance to merit consideration in shoreline revegetation programs in the south-central United States. Two herbaceous species, Aruno donax and Panicum virgatum, appear to be well adapted to a range of inundation conditions, including up to 7 weeks of growing season flooding. Woody species were generally less successful than herbaceous species, but several, especially Salix nigra, demonstrated considerable inundation tolerance. Experimental data presented in this report should facilitate planting programs by providing an indication of species tolerances of a range of potential inundation depth and duration conditions. (Author's abstract)
W86-05805

EVAPOTRANSPIRATION OF SMALL CONIFERS,

Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 2D.
W86-05918

EVAPOTRANSPIRATION MODEL FOR SEMI-ARID REGIONS,

Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2D.
W86-05920

WATER USE CHARACTERISTICS OF DACTYLIS GLOMERATA L., LOLIUM PERENNE L. AND L. MULTIFLORUM LAM. PLANTS,

Welsh Plant Breeding Station, Aberystwyth. Crop Genetics Group.
H. Thomas.
Annals of Botany ANBOA4, Vol. 57, No. 2, p 211-223, February 1986. 4 fig, 3 tab, 24 ref.

Descriptors: *Water requirements, *Grasses, *Plant physiology, Cocksfoot, Ryegrass, Drought resistance, Leaves, Roots, Transpiration.

Cocksfoot (Dactylis glomerata L.), perennial ryegrass (Lolium perenne L.), and Italian ryegrass (L. multiflorum Lam.) plants were grown on deep (75-95 cm) columns of soil in greenhouses and growth rooms with and without irrigation. The species in which growth declined least rapidly after water had been withheld were those that transpired most slowly. During early establishment in the greenhouse, cocksfoot transpired least because of slow root growth. In the growth room, when root systems were deeper and denser, perennial ryegrass transpired least due to low leaf water conductance. Results are discussed in relation to (1) drought resistance in the three species; (2) breeding for increased drought resistance through modifying root distribution and leaf water conductance; and (3) the use of isolated soil columns in water relations studies. Breeding for improved for water-use efficiency through a reduced root system may confer drought resistance in perennial temperate grasses only during establishment only. Restriction of transpiration through reduction in leaf water conductance has the advantages that water is conserved and tissue water stress is reduced. Disadvantages are that there is less evaporative cooling and CO2 assimilation may be reduced. (Doria-PTT)
W86-05933

EFFECTS OF DISTURBANCE ON MARSH SEED BANKS,

Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
L. M. Smith, and J. A. Kadlec.
Canadian Journal of Botany CJBOAW, Vol. 63, No. 12, p 2133-2137, December 1985. 2 tab, 44 ref.

Descriptors: *Seeds, *Marshes, *Germination, *Water level fluctuations, Drawdown, Wetlands, Great Salt Lake, Marsh plants, Flooding, Aquatic plants, Salinity, Fire, Vegetation regrowth.

Seed numbers and the species composition of seed banks (germinable seeds) from a marsh adjacent to the Great Salt Lake were compared among five vegetation types prior to and during a drawdown, prior to and after fire, and after restoration of normal water levels. Substrate samples were processed in the greenhouse under submersed and moist soil treatments to simulate the two germination conditions found in the field. After the fire, seed movement into the different vegetation types was also estimated. Numbers of germinable seeds were not depleted during the drawdown, possibly owing to increased salinity and the presence of standing vegetation. Fire had little effect on seed banks and subsequent seedling response. In general, seed banks were not affected by disturbance (e.g., burning, drawdown). The movement of seeds into the different vegetation types indicated that seed ingress could be important when one considers potential vegetation change. Seed banks of open water sites contained few germinable seeds compared with Scirpus lacustris, S. maritimus, Distichlis spicata, and Typha spp. sites. Open water sites were devoid of vegetation and had few physical barriers, and seeds continued to move through air or water across these areas until a barrier was reached (e.g., sites with vegetation). (Doria-PTT)
W86-05937

WHOLE-PLANT CARBON BALANCE DURING OSMOTIC ADJUSTMENT TO DROUGHT AND SALINITY STRFSS,

K. J. McCree.
Australian Journal Plant Physiology, Vol. 13, No. 1, p 33-43, 1986. 6 fig, 32 ref.

Descriptors: *Salinity, *Drought, *Crop production, Carbon balance, Photosynthesis, Osmotic adjustment, Sorghum, Water stress, Agricultural.

The whole-plant daily carbon balance (the 24 hour sum of photosynthetic input of substrate carbon per plant and loss of carbon through respiration) is the CO2 exchange measure that relates most closely to crop production rates. Water stress reduces the photosynthetic input, reducing both leaf area and photosynthetic rate per unit leaf area. Respiratory losses are reduced more or less proportionately. A less than proportional loss was observed during osmotic adjustment in sorghum (Sorghum bicolor (L) Moench): the metabolic cost of storing photosynthate and using it for osmotic adjustment was less than the cost of converting it to new biomass. A slightly increased metabolic cost is often found under salt stress but, in sorghum plants that were salinized and then water stressed, the adverse effects of salt were mitigated by decreased water loss rates and enhanced osmotic adjustment during water stress. More tests involving combined salt and water stress are needed. The physiological literature has little to say on the subject of water stress in the presence of salt, despite its obvious practical importance. (Peters-PTT)
W86-05955

METABOLIC EFFECTS OF WATER AND SALINITY STRESS IN RELATION TO EXPANSION OF THE LEAF SURFACE,

Waite Agricultural Research Inst., Glen Osmond (Australia). Dept. of Plant Physiology.
D. Aspinall.
Australian Journal Plant Physiology, Vol. 13, No. 1, p 59-73, 1986. 2 tab, 4 fig, 71 ref.

Descriptors: *Salinity, *Water stress, *Metabolism, Leaf expansion, Metabolic dysfunction, Organic solutes, Plant physiology.

Leaf expansion is comparatively sensitive compared to the onset of stress, and metabolic dysfunctions purported to contribute to the leaf expansion response can be judged against this sensitivity. Accumulated evidence does not support the proposition that leaf expansion is controlled primarily by the availability of basic metabolites during exposure to stress, nor is there any evidence for the primary of any specific metabolic lesion. Certain metabolic consequences of stress, particularly those leading to the accumulation of specific organic solutes, are viewed as adaptive. Such responses must be viewed in the light of their metabolic costs and the possibility that they contribute more to survival than to continued growth and expansion. The orderly inhibition of synthetic pathways in the expanding tissues and the switching of incoming substrate to compatible solute production upon stress suggests coordination of the stress response, which may be achieved through growth itself or through response to cell turgor, osmotic potential, or water potential. (Peters-PTT)
W86-05956

ION RELATIONS OF PLANTS UNDER DROUGHT AND SALINITY,

Sussex Univ., Brighton (England). School of Biological Sciences.

T. J. Flowers, and A. R. Yeo.
Australian Journal Plant Physiology, Vol. 13, No. 1, p 75-91, 1986. 2 tab, 5 fig, 73 ref.

Descriptors: *Salinity, *Drought, *Osmotic pressure, Leaf cells, Osmotic adjustment, Ions, Xenophytes, Mesophytes, Halophytes, Toxicity, Sodium.

The relations of mature leaf cells of plants growing under saline conditions are reviewed. Ions are of fundamental importance to the water relations of leaf cells. Under saline conditions, their continued cellular function depends upon osmotic adjustment with more ions, and to be successful these ions must be accumulated into the protoplast at the rate at which they are supplied. A failure to do this results in dehydration either through underadjustment or water loss to the cell walls. The situation under drought conditions is more complex. For xerophytes ions are important in the generation of low osmotic potentials, although physical properties of the plant are also vital to drought-tolerance. However, for mesophytes adapting top a drought, the supply of ions from the roots is limited (by diffusion through the soil) and they have a relatively minor role in osmotic adjustment. For succulent halophytes (Suaeda maritima), the demand for osmotic adjustment in the leaves matches closely (perhaps exceeds) the supply from the roots. Expanding leaves accumulate sodium at a greater rate than expanded leaves and apoplastic salt concentrations do not exceed those in the protoplast. for salt-sensitive species (Oryza sativa) supply exceeds demand, resulting in a sustained rate of xylem delivery of sodium to the expanded leaves. This in turn leads to either excessive apoplastic ion concentrations in the leaves and death through dehydration or excessive symplastic concentrations and death through ion toxicity. (Peters-PTT)
W86-05957

WHOLE-PLANT RESPONSES TO DROUGHT,

Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Pflanzenoekologie.
E. D. Schulze.
Australian Journal Plant Physiology, Vol. 13, No. 1, p. 127-141, 1986. 7 fig. 66 ref.

Descriptors: *Drought, *Humidity, *Plant water relations, Carbon, Stomata, Photosynthesis, Soybeans, Xylem, Plant physiology, Leaves, Water potential.

The partitioning of carbon and interactions which cause limitation on gas exchange and plant growth under conditions of a limited supply of water and nutrients are discussed. Possible mechanisms of effects of air humidity on stomatal functioning and carbon assimilation are described. There is a direct response of stomata and CO(2) assimilation to changes in air humidity which limits the luxes of CO(2) and vapor loss at the leaf level and which determines the canopy transpiration when the aerodynamic boundary resistance is small. A direct signal from the root to the stomata appears to regulate leaf conductance as the soil dries but prior to leaf wilting. It is possible that this signal also affects CO(2) assimilation, but the effect on photosynthesis appears to be species-dependent. Plant water relations interact with carbon partitioning, but the underlying mechanisms are obscure. An adverse xylem water potential can stop extension growth in soybean seedlings. Within whole plants, however, effects of xylem water potential on leaf expansion become more complex. They must be integrated with signals from the roots, which grow faster when leaf growth is diminished. With moist soil, but dry air, plant growth is probably reduced by short term perturbations in the leaf water balance. Stem growth can also be promoted without signals from the subtending shoot, excepting the flow of water within the xylem. The plant internal water status may not affect gas exchange and carbon partitioning significantly unless the plant fails to maintain a flow of water through the epidermis and through the root tips. (Peters-PTT)
W86-05958

WHOLE-PLANT RESPONSES TO SALINITY,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
R. Munns, and A. Termaat.
Australian Journal Plant Physiology, Vol. 13, No. 1, p 143-160, 1986. 1 tab, 9 fig, 87 ref.

Descriptors: *Salinity, *Halophytes, *Leaves, Roots, Macronutrients, Shoot water potential, Apoplast, Carbohydrates, Water potential, Toxicity.

The whole-plant responses to salinity are discussed to answer the question of what limits growth of non-halophytes in saline soils. Leaf growth is more sensitive to salinity than root growth. Effects of short-term exposures are considered separately from long-term exposure. Concentrated macronutrients have the same effect as isosmotic NaCl in the short term. Increased shoot water potential does not increase growth. Rate of transport of Na(+) of Cl(-) to the shoot does not correlate with rapid growth rate. There is rapid growth recovery on rewatering despite no change in tissue Na(+) or Cl(-) levels. Excess salt builds up in apoplast. Concentrated macronutrients are less toxic than isosmotic NaCl in the long term. Excess salt causes death of oldest leaves. Low carbohydrate reserves may affect growing regions. (Peters-PTT)
W86-05959

SALINITY RESISTANCE IN RICE (ORYZA SATIVA L.) AND A PYRAMIDING APPROACH TO BREEDING VARIETIES FOR SALINE SOILS,

Sussex Univ., Brighton (England). School of Biological Sciences.
For primary bibliographic entry see Field 3C.
W86-05960

ADAPTATION TO WATER DEFICITS: A CHANGING PERSPECTIVE,

Commonwealth Scientific Industrial Research Organization, Wembley (Australia). Lab. for Rural Research.
N. C. Turner.
Australian Journal of Plant Physiology, Vol. 13, No. 1, p 175-190, 1986. 3 tab, 5 fig, 92 ref.

Descriptors: *Plant tissues, *Water deficit, *Stomata, Soils, Roots, Shoots, Water stress, Leaf hydration, Growth, Plant physiology, Drought.

This review examines the evidence for turgor as a transducer of stress, the evidence for the root as the sensor of soil water deficits, the possible role of plant growth regulators in transferring water deficits, the possible role of plant growth regulators in transferring signals indicating increasing soil water deficits from the root to the shoot, and reevaluates the various phenological, physiological and morphological mechanisms of adaptation to stress in relation to the changing perception of the control mechanisms. The current developments on the role of leaf hydration on leaf growth and stomatal action are not always closely correlated with changes in leaf hydration. Soil and root water relations affect leaf growth and stomatal function. A role for plant growth regulators is postulated. The influence of this changed perspective on the adaptation of plants to water deficits is discussed. The importance of the adaptation of roots to water deficits is highlighted and the need for more studies on the interaction between the shoot and the root is emphasized. (Peters-PTT)
W86-05961

RESISTANCE TO DROUGHT AND SALINITY: AVENUES FOR IMPROVEMENT,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 3F.
W86-05962

WATER TRANSFER BY PLANT ROOTS FROM WET TO DRY SOIL,

Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 2D.
W86-05964

PHYSIOLOGICAL RESPONSES OF THREE NORTHERN CONIFERS TO RAPID AND SLOW INDUCTION OF MOISTURE STRESS,

Waterloo Univ. (Ontario). Dept. of Biology.
G.F. Buxton, D. R. Cyr, E. B. Dumbroff, and D. P. Webb.
Canadian Journal of Botany CJBOAW, Vol. 63, No. 7, p 1171-1176, July 1985, 2 fig, 6 tab, 21 ref.

Descriptors: *Conifers, *Moisture Stress, *Plant water potential, Black Spruce, White Spruce, Jack Pine, Physiological ecology, Water potentials, Osmotic pressure, Turgidity, Transpiration, Plant growth.

The response of black and white spruce and jack pine to slow and rapid induction of moisture stress was evaluated during soil drying and exposure to liquid cultures of polyethylene glycol 8000. Marked changes in water, osmotic, and pressure potentials were observed in all three species, but water potentials were the most sensitive indicators of moisture stress. The highest resistance to loss of turgor and the maximum adjustment to moisture stress were observed in white spruce. Shoot growth and transpiration declined in the three conifers at relatively low stress intensities. (Authors' abstract)
W86-06001

DISTRIBUTION OF XYRIS DIFFORMIS ALONG A GRADIENT OF EXPOSURE TO WAVES: AN EXPERIMENTAL STUDY,

Ottawa Univ. (Ontario). Dept. of Biology.
S. D. Wilson, P. A. Keddy, and D. L. Randall.
Canadian Journal of Botany CJBOAW, Vol. 63, No. 7, p 1226-1230, July 1985, 4 fig, 1 tab, 24 ref.

Descriptors: *Plant Growth, *Shoreline cover, *Wave Action, *Macrophytes, Lakes, Ontario, Vegetation, Bionmass, Seeds, Germination.

The distribution of a shoreline macrophyte, Xyris difformis, was measured along a gradient of exposure to wave action in several central Ontario lakes. Its abundance changed significantly along the exposure gradient, and occurred most frequently on shores of intermediate exposure. This distribution pattern could result from (i) maximum growth rates on intermediate-exposed shores, or (ii) competitive displacement from less exposed, sheltered shores that have little disturbance, high nutrient concentrations, and dense vegetation. Ramets were grown in the absence of neighbors (potential competition) along the exposure gradient on a lakeshore. Biomass varied with position on the exposure gradient. Maximum biomass occurred on shores of intermediate and high exposure. The proportion of seeds germinating below the waterline on substrates from sheltered shores was significantly lower than the proportion from exposed shores. (Authors' abstract)
W86-06002

CHANGES IN THE TOTAL ALKALOID CONTENT OF DATURA INNOXIA MILL. SUBJECTED TO SALT STRESS,

Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Lab. du Phytotron.
J. Brachet, and L. Cosson.
Journal of Experimental Botany, Vol. 37, No. 178, p 650-656, May 1986. 4 fig, 2 tab, 15 ref.

Descriptors: *Plant growth, *Alkaloids, *Salt stress, Scopolamine, Hyoscyamine, Plant water potential.

Datura innoxia plants were grown on a clayed support (Terra green) and subjected to salinity stress (153.8 mol per cu m NaCl) at the 6-leaf stage. The alkaloid content was calculated as the amount of scopolamine in leaves and stem (scopolamine being the dominant alkaloid in shoot) and as the amount of hyoscyamine in the root. The salt treatment increased total alkaloid content in young leaves. The principal determining factors in tropane alkaloid accumulation during the vegetative

stage of development of D innoxia are leaf and stem expansion and root proliferation. Salt stress increased this accumulation of alkaloids in young leaves. (Rochester-PTT)
W86-06032

SALINITY OF MOTORWAY SOILS. IV. EFFECTS OF SODIUM CHLORIDE ON SOME NATIVE BRITISH SHRUB SPECIES, AND THE POSSIBILITY OF ESTABLISHING SHRUBS ON THE CENTRAL RESERVES OF MOTORWAYS,

Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
For primary bibliographic entry see Field 5B.
W86-06036

CHANGES OF IN-CHANNEL VEGETATION FOLLOWING TWO-STAGE CHANNEL CONSTRUCTION ON A SMALL RURAL CLAY RIVER,

University Coll., London (England). Dept. of Geography.
For primary bibliographic entry see Field 4A.
W86-06037

BIOGEOCHEMICAL INFLUENCE OF VEGETATION AND SOILS IN THE ILWAS WATERSHEDS,

Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 5B.
W86-06094

MORPHOMETRIC VARIATIONS OF FIVE TIDAL MARSH HALOPHYTES ALONG ENVIRONMENTAL GRADIENTS,

Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 2H.
W86-06097

LOSS AND UPTAKE OF 15N-AMMONIUM IN SUBMERGED SOILS OF A CATTAIL MARSH,

Minnesota Univ., St. Paul. Dept. of Botany.
For primary bibliographic entry see Field 2H.
W86-06098

RESPONSE OF PINUS RADIATA SEEDLINGS TO CARBON DIOXIDE ENRICHMENT AT DIFFERENT LEVELS OF WATER AND PHOSPHORUS: GROWTH, MORPHOLOGY AND ANATOMY,

Macquarie Univ., North Ryde (Australia). School of Biological Sciences.
J. Conroy, E. W. R. Barlow, and D. I. Bevege.
Annals of Botany ANBOA4, Vol. 57, No. 2, p 165-177, February 1986. 1 fig, 7 tab, 35 ref.

Descriptors: *Carbon dioxide, *Phosphorus, *Available water, *Seedlings, *Plant morphology, *Plant growth, Conifers.

Eight week old seedlings of Pinus radiata, grown at three levels of phosphorus, were subjected to three watering regimes and to carbon dioxide concentrations of either 330 or 660 microliters per liter for 22 weeks. Carbon dioxide enrichment increased total dry weight by an average of 30% In phosphorus deficient seedlings the increase was only 13% whereas under water stress it was 38%. The net assimilation rate responded similarly to carbon dioxide. The number, length, diameter and specific weight of the needles was also increased by carbon dioxide enrichment, the effect being reduced by phosphorus deficiency but not by water stress. The increase in needle diameter was due to an increase in cell size rather than cell number. It may be inferred that increases in the yield of field grown Pinus radiata will occur even at sites where water limits growth. However, there is little possibility of improving growth where phosphorus deficiency is chronic. (Author's abstract)
W86-06123

EFFECT OF RATE OF DEHYDRATION ON LEAF WATER STATUS AND OSMOTIC ADJUSTMENT IN DACTYLIS GLOMERATA L., LOLIUM PERENNE L. AND L. MULTIFLORUM LAM,

Welsh Plant Breeding Station, Aberystwyth. Crop Genetics Group.
H. Thomas.
Annals of Botany ANBOA4, Vol. 57, No. 2, p 225-235, February 1986. 3 fig. 3 tab, 20 ref.

Descriptors: *Grasses, *Dehydration, *Leaf water potential, Water stress, Osmotic potential, Osmoregulation, Drought resistance.

Cocksfoot (Dactylis glomerata), perennial ryegrass (Lolium perenne) and Italian ryegrass (Lolium multiflorum) plants were grown in a glasshouse and in a controlled environment, and soil water deficits were allowed to develop slowly or rapidly. Changes in relative lamina water content, total lamina water potential and osmotic potential were measured as drought progressed. Osmotic adjustment (corrected to full turgor) was greatest when drought developed slowly. Perennial ryegrass adjusted most, by as much as 0.8 MPa. Cocksfoot, although the most drought tolerant species and most able to retain green leaves, was least able to adjust osmotically and maintain turgor during drought. Problems connected with measuring total lamina water potential of very stressed leaves, and with estimating osmotic potential at full turgor are described and analyzed. The use of various watering regimes in controlling leaf water status is discussed in relation to the selection of grasses for osmotic adjustment and turgor maintenance during drought. (Author's abstract)
W86-06124

WATER RELATIONS OF THE DUNE GRASSES AMMOPHILA ARENARIA AND ELYMUS MOLLIS ON THE COAST OF OREGON, USA,

Iowa State Univ., Ames. Dept. of Botany.
B. M. Pavlik.
Oikos, Vol. 45, No. 2, p 197-205, October, 1985. 6 fig, 37 ref.

Descriptors: *Plant water potential, *Grasses, *Osmotic pressure, *Diurnal distribution, *Salt tolerance, Seasonal variation, Dunes, Water stress, Transpiration, Oregon.

Predawn water potentials of Ammophila arenaria and Elymus molis were never more negative than -0.2 MPa and midday minima did not drop below -2.0 MPa during the May to October study period. Both species were probably rooted in a salt-free water table that did not oscillate seasonally. Diurnal fluctuations of plant water potential were the result of large reductions of blade turgor pressure as water deficits developed. Eventually, both species responded to the lower water potentials of midsummer with partial stomatal closure, reductions in blade transpiration, and increases of osmotic pressure in the blade tissues. Despite the moderate range of plant water potentials, these species experienced and acclimated to water stress. The stress was imposed by factors associated with the atmosphere and the plants themselves, rather than with the dune substrate. The diurnal rates of water potential and turgor pressure decline were significantly lower and midday water potentials consistently higher in Ammophila than in Elymus. Blades of Ammophila maintained higher stomatal conductances and rates of transpiration over the study period. Seasonal increases of osmotic pressure at full hydration were significant in blades of Elymus as midday water potentials declined through the summer. This resulted in the generation of higher turgor pressures when the blades were fully hydrated and the maintenance of higher turgor during the periods of lowest potential. In Ammophila the increases of osmotic pressure were less pronounced and did not result from solute accumulation. (Geiger-PTT)
W86-06140

EFFECT OF WATER LEVEL ON DESICCATION OF SPHAGNUM IN RELATION TO SURROUNDING SPHAGNA,

Uppsala Univ. (Sweden). Inst. of Ecological Botany.
H. Rydin.
Oikos, Vol. 45, No. 3, p 374-379, December, 1985. 4 fig, 1 tab, 25 ref.

Descriptors: *Water level, *Drying, Water stress, *Soil-water-plant relationships, *Mosses, *Bogs, Water level fluctuations, Marsh plants, Plant populations, Peat bogs, Drought, Drought resistance.

Desiccation of Sphagnum during periods of dry weather and low water table in a mire was followed by measuring the capitulum water content. The lower the water content, the greater the desiccation. For four investigated species desiccation increased in the order S. fuscum < S. rubellum < S. balticum < S. tenellum. The same ranking was found in a laboratory experiment in which the species were exposed to a gradually lowered water table. This ranking was related to the uppermost levels reached by the species on the hummocks of the mire. It is argued that the frequency and degree of desiccation, being more severe in the hollow species, may prevent these from growing in the hummocks. The specific identity of the Sphagnum surrounding the investigated capitulum has a profound effect on the course of its desiccation. Capitula of a species that normally dries out quickly (S. balticum, S. tenellum) benefit from being surrounded by shoots of superior species (S. fuscum, S. rubellum). This may explain the observation that individual shoots of S. balticum can be found at a higher level above the water table in a S. fuscum-hummock than in single-species carpets of S. balticum. This may be interpreted as a case of commensalism, acting in combination with competition. (Author's abstract)
W86-06142

WATER RELATIONS AND GROWTH CHARACTERISTICS OF PROSOPIS GLANDULOSA VAR. TORREYANA IN A SIMULATED PHREATOPHYTIC ENVIRONMENT,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
E. T. Nilsen, R. A. Virginia, and W. M. Jarrell.
American Journal of Botany AJBOAA, Vol. 73, No. 3, p 427-433, March, 1986. 4 fig, 4 tab, 22 ref.
NSF Grant DEB-79-219-1, DOE:AC03-76-76-SF00012.

Descriptors: *Water stress, *Phreatophytes, *Drought resistance, *Nitrogen, *Salinity, Water potentials, Plant water potential, Water use, Leaf water potential, Conductance, Soil water potential, Sonoran Desert, Transpiration.

Recent studies of Prosopis glandulosa, a phreatophytic tree of the Sonoran Desert, have demonstrated a unique system of a deeply rooted species with a significant water stress tolerance. Several growth and developmental characteristics have been correlated with water stress and nitrogen availability during field studies. Laboratory studies were conducted in which a phreatophytic regime was simulated and the availability of nitrogen and water was varied. Increased groundwater salinity caused lower plant water potentials and greater osmotic adjustment without significant increases in leaf sodium ion concentration. Leaf conductance was higher in the higher salinity treatments. Low water potential was also associated with reduced leaf size, reduced leaf area per plant and increased root to shoot ratio. Specific leaf weight and the transpiration ration were unaffected by the low water potentials induced by increased salinity. Increasing nitrogen availability caused increased growth rates but did not affect water use efficiency. Net assimilation rates increased with increasing nitrogen availability while relative growth rates were more dependent on overall plant size than treatment conditions. The responses of P. glandulosa to the simulated phreatophytic environment were similar to those predicted by field measurements. (Geiger-PTT)
W86-06147

2J. Erosion and Sedimentation

PROFILE OF SUSPENDED SEDIMENT DUE TO WAVE ACTION,

Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 2L.
W86-05501

WAVE PROPAGATION OVER A SEDIMENT TRENCH,

Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
For primary bibliographic entry see Field 2L.
W86-05502

THERMOEROSION OF FROZEN SEDIMENT UNDER WAVE ACTION,

Delaware Univ., Newark. Dept. of Civil Engineering.
N. Kobayashi, and D. Aktan.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 112, No. 1, p 140-158, January 1986. 5 fig, 23 ref, 2 append.

Descriptors: *Thermoerosion, *Wave action, *Heat conduction equation, *Frozen sediment, *Beaufort sea, Analytical solutions, Arctic, Frozen gravel causeway, Tundra Cliffs, Ice-bonded sediments, Thermal processes, Coastal engineering, Storms, Cold regions, Mathematical models.

Ice-bonded sediment is present in tundra cliffs and gravel structures in the southern Beaufort Sea. Thermoerosion of the frozen sediment under wave action can be important in determining the rate of coastal retreat and the severity of erosion of a gravel structure. The thermal processes involved in the thermoerosion of frozen sediment were examined, assuming that the transport capacity of the wave action exceeds its melting capacity. The location of the melting surface of the frozen sediment is determined by solving the heat conduction equation in the frozen sediment exposed to wave action, which causes the convective heat transfer between the sea water and the frozen sediment. Analytical solutions are presented for simplified one-dimensional problems. A two-dimensioanl finite element method based on a fixed domain approximation is proposed to facilitate the numerical computation. The example computation made for a frozen gravel causeway indicates that the melting of the frozen gravel will occur rapidly under the assumed storm conditions if the melted sediment is removed by wave action. A more realistic prediction of the thermoerosion of the frozen sediment under wave action requires the coupling of the thermal, wave, and sediment transport analyses at the interface between the sediment and fluid. (Rochester-PTT)
W86-05504

BLUFF RECESSION RATES IN CHESAPEAKE BAY,

Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2L.
W86-05505

EFFECTS OF CROSS DYKES ON ALTERNATE BARS,

Public Works Research Inst., Tsukuba (Japan).
S. Abe.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982. Exeter, England. p 311-318, 10 fig.

Descriptors: *River beds, *River flow, *Cross dykes, *Alternate bars, Alluvial rivers, River mechanics, Dikes, Channel erosion, Channel scour, Channels.

Alternate bars are liable to be formed on the river bed of torrential rivers on alluvial fans, so that meandering and local scouring due to the bar formation have often resulted in damage to channel works. Control measures against bars which have detrimental effects on channels are studied by means of hydraulic experiments, and cross dykes such as bed girdle and ground stills are proved to be effective. Cross-dyke arrangement, footing depth and height of revetment are discussed taking bar formation mechanisms into consideration. The correlation between the height of alternate bars Hsmamx and the scouring depth Hamax is Hamax = 0.8Hsmax. The height of bars varies in proportion to the interval between cross dykes. The optimum interval is approximately twice the channel width in the region of $5<B$/square root of $Q<10$, where B is the channel width and Q the designed discharge. (See also W86-05610) (Author's abstract)
W86-05641

DYNAMICS OF SUSPENDED SEDIMENT CONCENTRATION IN AN ALPINE PRO-GLACIAL STREAM NETWORK,

Southampton Univ. (England). Dept. of Geography.
A. M. Gurnell.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982. Exeter, England. p 319-330, 5 fig, 1 tab, 12 ref.

Descriptors: *Glaciers, *Suspended sediments, *Sediments, Hydrology, Hydrological aspects, Alpine regions, Mountains, Streams, Sediment yield, Valais, Switzerland, Tsidjiore Nouve Glacier.

Spatial and temporal variations in suspended sediment concentration in the pro-glacial stream network of the glacier de Tsidjiore Nuve, Val d'Herens, Valais, Switzerland are described. Substantial variations in concentration both between tributaries and down the main stream are used to identify controls on the observed concentration patterns and to improve research design. It is concluded that hourly sampling is insufficient to accurately assess sediment load in a pro-glacial stream because the temporal suspended sediment concentration pattern is characterized by rapid flushes of sediment. In addition, it is suggested that non-glacial sediment sources can rapidly disguise the pattern of sediment yield with increasing distance from the glacier snout, particularly during periods of intermediate to high discharge. (See also W86-05610) (Author's abstract)
W86-05642

HYDROLOGICAL ASPECTS OF EROSION ON MOUNTAINOUS TERRAIN - AN EXAMPLE FROM THE HIMALAYAN REGION, INDIA, BASED ON PHOTO-INTERPRETATION,

Indian Photo-Interpretation Inst., Dehra Dun.
R. C. Lakhera.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982. Exeter, England. p 343-350, 3 fig, 2 ref.

Descriptors: *Erosion, *Hydrological aspects, *Hydrology, *Alpine regions, *Geohydrology, Mountains, Runoff, Mass wasting, Precipitation, Aerial photography, Himalayas, India.

The application of aerial photo-interpretation for the qualitative analysis of erosional phenomena related to hydrological aspects in a selected pilot area of Uttar Pradesh Himalaya is discussed. In such terrain, erosion, aggravated by different mass-wasting processes, is a common feature. Slates, dolomitic limestone and quartzite (Garhwal Group) of Silurian to Pre-Cambrian age and Schist, gneiss and calc-silicate rocks (Central Crystalline) of Pre-Cambrian age are the dominant rock types. Structural and denudational hills are the major geomorphic units. Depending upon the rate and intensity of different mass-wasting processes, slope aspects, vegetational cover, etc., the area has been divided into five erosional classes: high erosion, moderately high erosion, moderate erosion, moderately low erosion and low erosion. One of the important factors contributing to mass erosion in the higher Himalaya is high intensity rainfall leading to enormous surface runoff resulting in erosion on moderate to steep slopes. (See also W86-05610) (Author's abstract)
W86-05644

DETERMINATION OF RIPPLE GEOMETRY,

Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-05856

PREDICTION OF 2-D BED TOPOGRAPHY IN RIVERS,

Waterloopkundig Lab. te Delft (Netherlands).
N. Struiksma.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 8, p 1169-1182, August 1985. 8 fig, 2 tab, 12 ref, 2 append.

Descriptors: *Model studies, *Channel morphology, *Sediment transport, *Mathematical models, *Rivers, Topography, Bed load, Waal River, Netherlands, Deformation, Alluvial Rivers, Simulation, Cooling water.

Mathematical models are being developoed at the Delft Hydrauliics Laboratory for the computation of time-dependent, two-dimensional bed deformation in alluvial rivers. A promising verification of the predictive capacity of one such model has been obtained for the Waal River in the Netherlands. This model was developed for rivers with approximately constant width. Some results of computations with variable boundary conditions are given which simulate the effect of the river regime and the extraction and return of cooling water on the bed topography. Due to the restricted number of grid points, the model can only reproduce river reaches of a relatively small length. However, if a river geometry can be modeled approximately by a series of circular bends with constant width and the sediment transport classifed as bed load without significant grain sorting effects, the model can be useful, for the assessment of river engineering designs. (Jones-PTT)
W86-05858

ESTIMATION OF HYDRAULIC DATA BY SPLINE FUNCTIONS,

Kanazawa Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-05859

POWER OF A RAINSHOWER (PUISSANCE D'UNE AVERSE),

Institut Royal Meteorologique de Belgique, Brussels. Hydrology Section.
For primary bibliographic entry see Field 2B.
W86-05899

EROSION OF SOFT COHESIVE SEDIMENT DEPOSITS,

Central Water and Power Research Station, Poona (India).
T. M. Parchure, and A. J. Mehta.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 10. p 1308-1326, October 1985, 13 fig, 2 tab, 17 ref, append. EPA Grant No. R806684010.

Descriptors: *Erosion, *Sediment, *Sediment deposits, Estuaries, Shear stress, Consolidation, Salinity, Modeling.

The erosive behavior of soft cohesive sediment deposits, which are representative of the top, active layer of estuarial beds was investigated. An experimental procedure involving layer by layer erosion under a range of bed shear stresses of successively increasing magnitude was utilized. Interpretation of the resulting concentration-time data together with bed density profiles yielded a description of the variation of the bed shear strength with depth as well as an expression for the rate of surface erosion. In general, bed shear stresses increased with depth and was also influenced by the type of sediment, bed consolidation period and salinity. The rate of erosion was varied exponentially. The influence of salinity on erosion is important only if it is <10 ppt. In modeling estuarial bed erosion, it is essential to take these

characteristics of bed shear strength and rate of erosion into account. (McFarlane-PTT)
W86-05969

SEDIMENT TRANSPORT IN SHALLOW FLOWS,
Clemson Univ., SC.
N. M. Aziz, and S. N. Prasad.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 10, p 1327-1343, October 1985, 12 fig, 23 ref, append.

Descriptors: *Sediment transport, *Soil erosion, *Furrow irrigation, Furrows, Model studies, Hydraulic properties, Channel morphology, Shallow water, Flow properties, Farming.

The sediment transport problem in shallow flows, such as furrow flows, in the upper flow regime was formulated based upon continuum mechanics principles. Considering the dynamics of the water flow as well as the dynamics of sediment flow, a mathematical expression which is a modification of the classical stability criterion of flow over a fixed bed is obtained for the case when a movable sediment layer is present near the bed of the channel. Coincident with this stability criterion, the amount of sediment being moved is defined as the transport capacity on the sediment properties, active layer thickness, channel gradient and the hydraulic properties of the flow. Comparison of the theoretical resuls with experimental data revealed a general agreement. In particular, the theory predicted satisfactorily the transport capacity in models of steep crop-row furrows. (Author's abstract)
W86-05970

MODELING OF RAINFALL EROSION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
P. Y. Julien, and M. Frenette.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 10, p 1344-1359, 6 fig, 3 tab, 29 ref.

Descriptors: *Model studies, *Erosion, *Rainfall erosion, *Soil erosion, *Overland flow, Sediment discharge, Sediment yield, Suspended load, Chaudiere River, Quebec, Rainfall-runoff relationships, Mathematical models.

A combined stochastic and deterministic method has been developed to evaluate soil erosion from overland flow. The exponential distributions for rainfall duration and intensity are combined with rainfall-runoff relationships for discrete storms. A general equation for sediment discharge is suggested from dimensional analysis with different sets of coefficients representing several existing equations. The expected value of soil erosion during one rainfall event is theoretically derived using hypergeometric series. When applied to the Chaudiere watershed near Quebec, this equation converges very rapidly, and the first term of the series is recommended. Utilizing sedimentdelivery ratios, the sediment yield computed from the total soil erosion is in good agreement with the suspended load measured in the river. (Author's abstract)
W86-05971

CULVERT SLOPE EFFECTS ON OUTLET SCOUR,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W86-05972

CHANNEL WIDTH ADJUSTMENT DURING SCOUR AND FILL,
San Diego State Univ., CA. Dept. of Civil Engineering.
H. H. Chang.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 10, p 1368-1370, October 1985, 1 fig, 4 ref.

Descriptors: *Channel scour, *Streambeds, *Channel morphology, Water surface profiles, Alluvial channels, Sediment transport.

Fluvial processes are governed by the principles of continuity, flow resistance, sediment transport and bank stability but such relations are insufficient to explain the time and spatial variations of channel width in an alluvial stream. The adjustment of stream channel width is explained by the stream's tendency to reach uniform power expenditure per unit channel length, that is, straight water-surface profile, along the channel. While straight water-surface profile is the direction toward which each stream channel evolves, channel width adjustment under this condition is not necessarily toward streamwise uniformity. It is shown that straight water-surface profile can be approached by significant streamwise variation in width during streambed scour and fill. (McFarlane-PTT)
W86-05973

LOCAL SCOUR DOWNSTREAM OF AN APRON,
Victoria Univ. of Manchester (England). Dept. of Civil and Structural Engineering.
For primary bibliographic entry see Field 8B.
W86-05974

BED TOPOGRAPHY IN BENDS OF SAND-SILT RIVERS,
Saitama Univ. (Japan). Dept. of Foundation Engineering.
S. Ikeda, and T. Nishimura.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 11, p 1397-1411, November 1985, 7 fig, 26 ref, append. Ministry of Education of Japan Grant No. 59550337.

Descriptors: *Channel morphology, *Meanders, *Lateral bed, Topography, Suspended sediment, Convective transport, Diffusion, Turbulence, Sand, Silt, Sediments, Mathematical models.

A mathematical model for defining the lateral bed topography in bends of sand-silt rivers is presented. The model includes the effects of suspended sediment that has not been considered in existing models. The major agency for defining the lateral bed profile is found in the force balance between the fluid force and the gravitational force exerting on bed materials. The theory suggests that the lateral convective transport of suspended sediment induced by secondary flow may considerably affect the bed profile at the outer region of river bends, while the lateral diffusion due to turbulence has negligible effect on the profile everywhere. The new model was applied to the Wabash River and gave results within acceptable limits of prediction error. (McFarlane-PTT)
W86-05976

FORMATION OF ALTERNATE BARS,
San Diego State Univ., CA. Dept. of Civil Engineering.
H. H. Chang.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 11, p 1412-1420, November 1985, 3 fig, 1 tab, 18 ref. NSF Grant No. CEE-8209029.

Descriptors: *Channel morphology, *Channeling, *Alluvial channels, *Meanders, Low flow, Flow discharge, High flow.

River channelization works have often resulted in alternate bar formation at low flows. A criterion for alternate bar formation in straight alluvial-bed channels with rigid banks is developed following a rational approach, and is substantiated with experimental data. The formation of alternate bars is attributed to meandering development within the confined channel. Such development becomes possible if the streamflow's stable width, or regime width, is less than the confinement width. The stable width is analytically established as a direct function of water discharge. If, at a high flow, the stable width is greater than the confinement width, then alternate bars are absent due to the lack of freedom for meandering development. (Author's abstract)
W86-05977

HYDRODYNAMICALLY SMOOTH FLOWS OVER SURFACE MATERIAL IN ALLUVIAL CHANNELS,
Delaware Univ., Lewes. Coll. of Marine Studies.
For primary bibliographic entry see Field 2E.
W86-05978

TURBITY CURRENT WITH EROSION AND DEPOSITION,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
J. Akiyama, and H. Stefan.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 12, p 1473-1496, December 1985. 14 fig, 26 ref. NOAA Grant No. NA 82AA-D-00039.

Descriptors: *Turbidity currents, *Sediment transport, *Sedimentation, *Erosion, *Deposition, *Reservoirs, Beaches, Sediment, Shear, Mathematical models, Suspended sediments, Particle size, Flow characteristics.

The equations which govern the movement of two-dimensional gradually varied turbidity currents in reservoirs and over beaches are derived and solved numerically. Turbidity currents are sediment-laden gravity currents that exchange sediment with the bed by erosion or deposition as the flow travels over the downslope. Turbidity currents derive this driving force from the sediment in suspension. They experience a resisting shear force on the bed and entrain water from above. Turbidity currents can be eroding or depositive, accelerating or decelerating, dependent on the combination of initial conditions, bed slope, and size of sediment particles. They can be controlled from upstream (supercritical) or downstream (subcritical). Gravity currents with and without erosion and deposition were examined to understand the effects of sediment exchange on the flow. In accelerating, erosive turbidity currents velocity the effects of settling or entrainment of sediment in large-scale flow become unappreciable relative to the size of the flowfield. There exists no internally normal flow condition for a turbidity current. On a constant slope, density currents never cease but turbidity currents do because: 1) the flow becomes subcritical which must lead to deceleration and sediment deposition, or 2) deposition may occur even in supercritical flow if the size of the sediment particles is large enough. (McFarland-PTT)
W86-05982

REVISION OF THE CHURCHILL RESERVOIR TRAP EFFICIENCY CURVES USING SMOOTHING SPLINES,
California Univ., Los Angeles. Dept. of Mathematics.
K. P. Bube, and S. W. Trimble.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 305-309, April 1986. 1 fig, 2 tab, 8 ref.

Descriptors: *Brune curves, *Churchill curves, *Trap efficiency, *Reservoirs, *Local sediments, *Sedimentation index, *Upstream sediments, Curve fitting, Sediment yield, Mathematical analysis.

The method of smoothing splines was employed to revise Churchill's curves for predicting reservoir trap efficiency. Churchill's curves are more descriptive than the standard Brune curves, but have not been revised since 1948, even though more data are now available. The revised curve for local sediment mostly lies slightly below the original curve in that reservoirs with small sedimentation efficiencies have positive local trap efficiencies. For example, at sedimentation index of 10,000 the local trap efficiency is zero (if not negative) by the original curve, but by the revised curve it is almost 20%. The revised curve is flatter from 1,000,000 to 10 to the 7th power with an increase of about 1.5% in local trap efficiency, partly because of the lack of data in this interval. The revised curve also tends to flatten out the original curve to cover sedimentation indices from 10 to the 8th power to 10 to the 9th power. The revised curve for upstream sediment agrees well with the original

curve except for a slight flattening in the interval from 10 to the 7th power to 5 x 10 to the 7th power. The original upstream curve was also extended to cover from 150,000 to 10 to the 8th power. (Rochester-PTT)
W86-06026

FATE OF 2,4-D ENTERING A FRESHWATER AQUATIC ENVIRONMENT,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5B.
W86-06074

UNIFIED BAR-BEND THEORY OF RIVER MEANDERS,
Genoa Univ. (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 2E.
W86-06144

2K. Chemical Processes

GROUNDWATER TRANSPORT OF STRONTIUM 90 IN A GLACIAL OUTWASH ENVIRONMENT,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 5B.
W86-05432

LIMESTONE INFLUENCES ON PHYSICAL AND CHEMICAL FEATURES OF A MOUNTAIN STREAM,
Oregon State Univ., Corvallis. School of Forestry.
G. L. Larson, R. C. Mathews, Jr., and R. Herrmann.
Ground Water GRWAAP, Vol. 24, No. 2, p 166-172, March-April, 1986. 9 fig, 5 ref.

Descriptors: *Surface-groundwater relations, *Geochemistry, *Streamflow, *Limestone, *Groundwater, Infiltration, Water quality, Abrams Creek, Cades Cove, Tennessee, Chemical reactions, Carbonate rocks, Water temperature, Temperature, Forest management.

Influences of limestone on physical and chemical characteristics of Abrams Creek in Cades Cove, Great Smoky Mountains National Park, were investigated from February to July 1977. Infiltration of stream water into subsurface permeable limestone conduits caused reduced and intermittent surface flow within the middle reach of the cove. At the downstream (west) edge of the Cove, inflowing waters characteristically warmed the stream in winter and cooled it in summer and increased stream conductivity, total hardness, and pH. Although management activities (e.g. forest clearing) affect the temperature of the waters, they did not appear to appreciably affect the chemistry of aquatic system downstream relative to the large effects of limestone substrate. (Cassar-PTT)
W86-05442

DIFFERENCES IN IONIC COMPOSITIONS AND BEHAVIOR IN WINTER RAIN AND SNOW,
Environmental Monitoring and Services, Inc., Newbury Park, CA.
For primary bibliographic entry see Field 5B.
W86-05466

RECENT PATTERNS OF SULFATE VARIABILITY IN PRISTINE STREAMS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W86-05467

IMPORTANCE OF REDUCING SAMPLE CONTAMINATION IN ROUTINE MONITORING OF TRACE METALS IN ATMOSPHERIC PRECIPITATION,
Stockholm Univ. (Sweden). Meteorologiska Institutionen.
For primary bibliographic entry see Field 5A.
W86-05498

ROLE OF THE OCEAN IN A REGIONAL SULFUR CYCLE,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
T. S. Bates, and J. D. Cline.
Journal of Geophysical Research JGRCEX, Vol. 90, No. C5, p 9168-9172, September 1985. 4 fig, 22 ref.

Descriptors: *Sulfur cycle, *Biogenic sulfur, *Dimethylsulfide, *Acid rain, Mathematical model, Path of pollutants, Chemical analysis, Water pollution sources, Atmospheric deposition, Surface waters.

Demethylsulfide (DMS) concentrations were measured in ocean waters along the West Coast of the United States during three cruises in 1983 and 1984. DMS concentrations in surface waters ranged from 13 to 380 nanograms S/L with a summer average of 60 and a winter average of 20 nanograms S/L. The flux of sulfur from the ocean to the atmosphere was calculated, using the stagnant film boundary layer model, to be 28 mg S/sq m/a. The average zonal near-surface wind velocities along the coast can be coupled with a mean sulfate tropospheric residence time to compute effective areas of sulfur production that will reach the coastal United States. On the basis of a non-sea sulfate residence time of 5 days, the calculated net flux of biogenic sulfur to the West Coast of the United States is 0.045 Tg/a. This is 4-13% of the combined total anthropogenic emissions from the United States. (Main-PTT)
W86-05536

ACID RAIN FALLS ON BRITISH WOODLANDS,
For primary bibliographic entry see Field 5B.
W86-05542

METALS IN LOW-ELEVATION, SOUTHERN APPALACHIAN FOREST FLOOR AND SOIL,
Emory Univ., Atlanta, GA. Dept. of Biology.
C. W. Berish, and H. L. Ragsdale.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 183-187, April-June 1986. 3 tab, 35 ref. NSF DEB-8012093.

Descriptors: *Metals, *Appalachian forests, *Litter, *Humus, *Availability, *Long-range transport, *Aerial deposition, North Carolina, Coweeta Basin, Northeastern United States, Soil chemistry, Calcium, Potassium, Magnesium, Manganese, Cadmium, Cobalt, Copper, Lead, Zinc, Typic Hapludults, Mineral soil.

Litter and humus and surficial (0-5 cm) and deeper (25-30 cm) mineral soil were collected from two 90-yr-old forests to measure readily-available, potentially-available, and total-pool quantities of metals in low elevation Southern Appalachian soils. Soil of the two forested watersheds are either in the Evard or Tate series, a fine-loamy, mesic family of Typic Hapludults. Concentrations of Ca, K, Mg, Mn, Cd, Co, Cu, Pb, and Zn in soils were determined by three extraction methods (water soluble, weak acid, and total dissolution). Total soil Ca, K, Mg, and Mn pools were two or more orders of magnitude greater than trace metal pools. Total soil metal pool at both depths followed a trend of K>> Ca> Mg> Mn>> Zn> Cu>> Pb> Co>> Cd. Fractions of the total metal pools that were readily and potentially available generally decreased with depth. Litter and humus trace metal concentrations of two low elevation watersheds in the Coweeta Basin (North Carolina) contain lower concentration of Cu, Zn, and Pb than commonly reported for the northeastern USA. Aerial deposition of Cd, Co, and Pb was indicated by the surficial forest floor enrichment in these elements compared to the mineral soil. The largest trace metal pool in forest floor litter and humus was for lead, and was presumably from long-range transport, deposition, and subsequent retention in humic materials. (Author's Abstract)
W86-05553

STABLE CARBON ISOTOPES AND CARBON FLOW IN ECOSYSTEMS,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
J. S. Rounick, and M. J. Winterbourn.
Bioscience, Vol. 36, No. 3, p 171-177, March 1986. 5 fig, 42 ref.

Descriptors: *Stable carbon isotopes, *Carbon cycle, *Carbon flow, *Isotopic tracers, *Ecosystem analysis, Biomass, Feeding habits, Terrestrial ecosystems, Inland waters, Estuarine ecosystems, Marine ecosystems, Carbon-13, Carbon-12, Carbon isotope ratios.

Stable carbon isotope analysis provides a novel alternative approach that can help elucidate carbon pathways and processes in both laboratory and field. The technique uses differences in the natural abundances of 13C and 12C as tags, or tracers, which move with little or no predictable alteration through food chains. Measuring stable carbon isotopes and application of the stable carbon isotope technique in terrestrial ecosystems, inland waters, and marine and estuarine ecosystems is reviewed. If two potential carbon sources have different 13c/12c ratios, the relative contribution of each resource to consumer biomass can be determined by a simple mixing method. Another promising ecological application of stable carbon isotope analysis is examining past feeding histories of animals with tissues that do not exchange too rapidly with the rest of the animal's carbon pool. Although further work is needed to improve its discriminatory ability, stable carbon isotope analysis is a valuable addition to the tools available to ecologists. (Rochester-PTT)
W86-05558

SPRING POND WATER CHEMISTRY AND THE REPRODUCTION OF THE WOOD FROG, RANA SYLVATICA,
Quebec Univ., Montreal. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W86-05569

TRACE METALS IN HUMIC ACIDS AND THEIR HYDROLYSIS PRODUCTS,
Central Inst. for Tumors and Allied Diseases, Zagreb (Yugoslavia).
For primary bibliographic entry see Field 5B.
W86-05571

SEPARATION AND DETERMINATION OF TRACES OF HEAVY METALS COMPLEXED WITH HUMIC SUBSTANCES IN FRESH WATERS BY SORPTION ON DIETHYLAMINOETHYL-SEPHADEX A-25,
Nagoya Univ. (Japan). Dept. of Engineering.
For primary bibliographic entry see Field 5A.
W86-05574

CHEMICAL MECHANISMS OF ACID GENERATION IN THE TROPOSPHERE,
National Center for Atmospheric Research, Boulder, CO. Atmospheric Chemistry Div.
For primary bibliographic entry see Field 5B.
W86-05597

DISSOLVED ZINC IN RIVERS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
For primary bibliographic entry see Field 5A.
W86-05598

VOLUNTARY COOPERATION FOR THE EXPLORATION OF GROUND WATER (COOPERATEURS VOLONTAIRES POUR L'EXPLORATION DES EAUX SOUTERRAINES),
For primary bibliographic entry see Field 4B.
W86-05733

SALINITY, CHLORIDE, AND DENSITY RELATIONSHIPS IN ION ENRICHED ONONDAGA LAKE, NY,
Upstate Freshwater Inst., Inc., Syracuse, NY.

For primary bibliographic entry see Field 5B.
W86-05841

SURFACE WATER CHEMISTRY IN THE ILWAS BASINS,
Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
For primary bibliographic entry see Field 5B.
W86-05907

ILWAS MODEL: FORMULATION AND APPLICATION,
Tetra Tech, Inc., Lafayette, CA.
S. A. Gherini, L. Mok, R. J. M. Hudson, G. F. Davis, and C. W. Chen.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 4, p 425-459, December 1985. 17 fig, 1 tab, 10 ref.

Descriptors: *Acid rain, *Acid lakes, *Model studies, *Chemical properties, Acidity, Cations, Soil chemistry, Chemical analysis, Watersheds, Organic compounds, Sulfur, Panther Lake, Woods Lake, Kinetics, Path of pollutants, Soil water.

The Integrated Lake-Watershed Acidification Study (ILWAS) model was developed to predict changes in surface water acidity given changes in the acidity of precipitation and dry deposition. The model routes precipitation through the forest canopy, soil horizons, streams and lakes using mass balance concepts and equations which relate flow to hydraulic gradients. The physical-chemical processes which change the acid-base characteristics of the water are simulated by rate (kinetic) and equilibrium expressions, and include mass transfers between gas, liquid, and solid phases. The aqueous constituents simulated include pH, alkalinity, the major cations and anions, monomeric Al and its inorganic and organic complexes, organic acid analogues and dissolved inorganic carbon. The ILWAS model has been used to predict changes in the acidity of Woods Lake and Panther Lake given reductions in total atmospheric S loads. Hypothesis testing with the model has shown that the routing of water through soils largely determines the extent to which incident precipitation is neutralized. Analysis of the two lake basins using the model and field data showed the watersheds to be net suppliers of base to the through-flowing water, although internal watershed production of strong acidity did occur. (Doria-PTT)
W86-05908

OXIDATION-INDUCED LEACHING OF SULPHATE AND CATIONS FROM ACID SULPHATE SOILS,
Helsinki Univ. (Finland). Dept. of Agricultural Chemistry.
For primary bibliographic entry see Field 2G.
W86-05909

ADSORPTION OF MERCURY COMPOUNDS BY TROPICAL SOILS,
Norges Landbrukshoegskole, Aas. Dept. of Soil Fertilization and Management.
For primary bibliographic entry see Field 2G.
W86-05911

ANALYSIS OF HYDRILLA-INHIBITING FRACTIONS IN NATURAL WATERS: THE CONCEPT OF 'FINGERPRINTING' THROUGH LIQUID CHROMATOGRAPHY,
University of South Florida, Tampa. Dept. of Chemistry.
For primary bibliographic entry see Field 4A.
W86-06023

SALINITY OF MOTORWAY SOILS. I. VARIATION IN TIME AND BETWEEN REGIONS IN THE SALINITY OF SOILS ON CENTRAL RESERVES,
Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
For primary bibliographic entry see Field 5B.
W86-06033

SALINITY OF MOTORWAY SOILS. II. DISTANCE FROM THE CARRIAGEWAY AND OTHER SOURCES OF LOCAL VARIATION IN SALINITY,
Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
For primary bibliographic entry see Field 5B.
W86-06034

SALINITY OF MOTORWAY SOILS. III. SIMULATION OF THE EFFECTS OF SALT USAGE AND RAINFALL ON SODIUM AND CHLORIDE CONCENTRATIONS IN THE SOIL OF CENTRAL RESERVES,
Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
For primary bibliographic entry see Field 5B.
W86-06035

SPRING CHARACTERISTICS AND HYDROLOGICAL MODELS OF CATCHMENTS, A CASE STUDY FROM ASTDALEN, S.E. NORWAY,
Norges Landbrukshoegskole, Aas. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W86-06163

2L. Estuaries

WATER QUALITY SIMULATION STUDY OF A NATURAL HARBOR,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-05500

PROFILE OF SUSPENDED SEDIMENT DUE TO WAVE ACTION,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
S. Vongvisessomjai.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 112, No. 1, p 35-53, January 1986. 12 fig, 2 tab, 17 ref, append.

Descriptors: *Suspended sediments, *Wave action, *Turbulence, *Nearshore processes, *Mass conservation equation, Sediment transport, Diffusion coefficient profile, Friction factor, Boundary layer thickness, Shear stress, Von Karman constant.

A knowledge of sediment transport due to wave action is required to understand the dynamic process of nearshore morphology; however, these phenomena of sediment transport due to waves are complicated by the unsteady characteristics of the flow, the presence of turbulence, and the interaction between the fluids and the sediment. Profiles of mean and unsteady concentrations were derived from the mass conservation equation using the diffusion coefficient profile adapted from the eddy viscosity profile, taking into account changes of the friction factor and boundary layer thickness in the presence of suspension. The theoretical profiles are expressed explicitly as functions of the friction factor, velocity and shear stress profile parameters, and the settling velocity of the sediment relative to the fluid velocity. The tabulated data available and the present experimental data of the mean concentration were used to fit the theoretical profile. The analysis shows that the friction factors in the presence of suspension decrease from the sediment-free values in the same manner and magnitude as the von Karman Constant. (Author's Abstract)
W86-05501

WAVE PROPAGATION OVER A SEDIMENT TRENCH,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
P. L.-F. Liu, B. R. Turcotte, and F. H. Kulhawy.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 112, No. 1, p 64-77, January 1986. 9 fig, 1 tab, 8, ref, append.
NSF Grant CEE-8200272.

Descriptors: *Wave propagation, *Sediment, *Trenches, Wave height, Wave action, Pressure.

Wave interactions with a sediment trench were examined both theoretically and experimentally. The envelope of the wave amplitudes in front of the sediment trench was measured to evaluate the wave reflection from the trench. Detailed pore water pressure measurements were also made above and within the sediment trench. The wave reflection was practically zero when the trench was filled with sand. The water pressure along the mudline is the same as that of wave propagation over a solid bottom. Potential theory adequately describes the velocity and pressure field when the trench is not filled with sand. However, when the trench is filled with sand, the Biot consolidation theory gives a better description of the pore water pressure field under wave loading than other theoretical models. (Rochester-PTT)
W86-05502

USE OF GROUT-FILLED SAUSAGES IN COASTAL STRUCTURES,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8D.
W86-05503

BLUFF RECESSION RATES IN CHESAPEAKE BAY,
Delaware Univ., Newark. Dept. of Civil Engineering.
R. A. Dalrymple, R. B. Biggs, R. G. Dean, and H. Wang.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 112, No. 1, p 164-168, January 1986. 2 fig, 2 tab, 4 ref.

Descriptors: *Bank erosion, *Beach erosion, *Chesapeake Bay, *Bluff recession, *Wave action, Sand, Silt, Littoral transport, Erosion rates, Mathematical analysis.

The three most relevant factors for bluff recession in Chesapeake bay are examined using data from four field sites. The composition of the bluff material is extremely important; the analysis is restricted to consolidated materials from silt to sand fractions. As sandy beaches exist at the toe of the bluffs at the four sites, the assumption is made that any silt eroded from the cliffs is immediately carried offshore by the waves while the sand fraction is introduced into the littoral system. The height of the bluff is another important factor because more slump material is provided to the beach for the same erosion rate from a higher bluff from a lower one. Finally, the littoral transport is responsible for the removal of slump material from the beach. (Rochester-PTT)
W86-05505

STABLE CARBON ISOTOPES AND CARBON FLOW IN ECOSYSTEMS,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2K.
W86-05558

MARSHES OF THE OCEAN SHORE: DEVELOPMENT OF AN ECOLOGICAL ETHIC,
San Francisco Univ., CA.
J. V. Siry.
Texas A & M University Press, College Station, TX. 1984. 216 p. $22.50.

Descriptors: *Estuaries, *Marshes, *Wetlands, *Ecology, Water policy, Oceanography, Political aspects, Wildlife, Legal aspects, Tidal lands, Coastal marshes, Environmental policy, Land reclamation, Jurisdiction, National Estuary Protection Act.

This book traces the interplay among scientific knowledge, popular values, legal frameworks, and public policy in the development of a wetlands, ecological ethic. The significance of marshes has been debated from ancient times. The Bible depicts

marshes as a necessary element in the creation of the earth. Drainage and transformation of marshes has been a goal for civilizations eager to gain agricultural land and prevent marsh-originating disease. Studies reveal the wetlands to be the earth's most productive and fertile natural areas. Conflicts exist between preservationists and commercial/recreational users of marshes. The goals and policies of wetlands ecology developed gradually until after World War II. Three stages are identified: colonial/preindustrial, industrial, and suburban. The National Estuary Protection Act of 1968 committed the country to planning for preservation of the wetlands. This and other legislation control dredging, waste dumping, and reclamation and encourage protection of wildlife and water quality. Conflicts still exist among government bodies responsible for safeguarding the wetlands. Important to continuing marshland preservation are retaining the functional integrity of surrounding environments and recognition of responsibility by the appropriate governmental bodies. (Cassar-PTT)
W86-05747

ALABAMA COASTAL REGION ECOLOGICAL CHARACTERIZATION; VOLUME 1, COASTAL BIBLIOGRAPHY,

Geological Survey of Alabama, University.
P. E. O'Neil, M. F. Mettee, E. J. McCullough, L. A. Acker, and D. W. Wilson.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-180661, Price codes: A21 in paper copy, A01 in microfiche. Report FWS/OBS-81/21, June 1982. 404 p. Contract No. 14-16-0009-80-1016.

Descriptors: *Estuaries, *Bibliographies, *Data collection, *Alabama, *Environmental effects, Water pollution, Monitoring, Ecology, Geohydrology, Hydrology, Invertebrates, Wildlife, Shellfish, Birds, Aquatic habitats, Habitats, Aquatic animals, Marine biology, Geology, Oceanography, Economic aspects, Social aspects, Tidal lands.

A bibliography on Mobile and Baldwin counties, coastal Alabama, provides background information on the environmental and socioeconomic facts of this region. Published and unpublished studies on the following main topics are listed: literature reviews and bibliographies, biology, estuaries, geology and geography, hydrology, maps and charts, meteorology, models, oceanography, environmental impact, pollution, monitoring, and socioeconomic facts. (Cassar-PTT)
W86-05748

COMPETITION FOR WATER RESOURCES OF THE RIO GUAYAS, ECUADOR,

Cremer and Warner Ltd., London (England).
P. J. Waite.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 79-88, 4 fig, 8 ref.

Descriptors: *Rainfall-runoff relationships, *Competing use, *Water pollution sources, *Saline water intrusion, Guayas River, Guayaquil, Ecuador, Reservoirs, Runoff, Water use, Estuaries, Rivers, Groundwater pollution, Aquifers, Low flow, Drought, Water supply, Irrigation requirements, Dams, Hydroelectric power.

Increasing demands on limited water resources have led to increased salt water intrusion hazards in many estuaries. A particular example from Ecuador is examined in this paper. Guayaquil obtains its water supply from the Rio Daule, one of the tributaries of the Rio Guayas. The river also supplies water for irrigation and other uses. Increasing use of the limited fresh water has resulted in such low residual fresh-water flow that salt water has intruded upstream to the water supply intake during the dry season. A major new development is the Daule-Peripa dam, for hydropower, irrigation and river control. It will be necessary to cater to all users of the Rio Daule water both during construction and after completion of the dam. It is difficult to measure the low flows in the estuary and data are only available for part of the basin. This paper describes the analysis of flow and in particular to evaluate the risk to the city water supply due to high salinity levels in the dry season. (See also W86-05750) (Author's abstract)
W86-05758

ALLOCATION OF FRESH WATER RESOURCES OF A TIDAL ESTUARY,

Southern Water Authority, Worthing (England).
For primary bibliographic entry see Field 4A.
W86-05784

CHESAPEAKE BAY LOW FRESHWATER INFLOW STUDY, PHASE II: BIOTA ASSESSMENT; MAP FOLIO,

Western Eco-Systems Technology, Inc., Bothell, WA.
For primary bibliographic entry see Field 6G.
W86-05791

NUMERICAL SIMULATION OF THE DISTRIBUTION OF WATER TEMPERATURE AND SALINITY IN THE SETO INLAND SEA,

Kyoto Univ. (Japan). Geophysical Inst.
M. Murakami, Y. Oonishi, and H. Kunishi.
Journal of the Oceanographical Society, Vol. 41, No. 4, p 213-224, September 1985. 11 fig, 3 tab, 22 ref.

Descriptors: *Water temperature, *Seto Inland Sea, *Salinity, Chemical properties, Seawater, Japan, Model studies, Density, Tidal currents, Seasonal variation, Simulation.

Constant flows, as well as oscillatory tidal flow, play an important role in the long-term dispersion of water in the Seto Inland Sea. Two kinds of numerical model (1-line and 2-line models) of the Seto Inland Sea were developed to determine the role of density-induced currents, one type of constant flow, in water dispersion in the Inland Sea. The seasonal variations of temperature, salinity and density fields were simulated and the density-induced current field was predicted at the same time. The most appropriate value of the longitudinal eddy diffusion coefficient, Kx, is 5x1000000-7x1000000 sq cm/sec. The value of the overall mean dispersion coefficient is of the order of 10 to the 7th power sq cm/sec. Consequently, it is suggested that 50-70% of the total dispersion in the Seto Inland Sea can be attributed to currents other than density-induced currents, i.e., tidal currents, tide-induced currents and wind-driven currents. In winter, both density and velocity fields, calculated using the 1-line model, satisfy the conditions for the existence of a coastal front in Kii Channel and in eastern Iyo-nada. (Master-PTT)
W86-05815

VERTICAL TWO-DIMENSIONAL MECHANISM OF TIDAL EXCHANGE IN A BAY WITH A SILL-ENTRANCE; PART 1, OBSERVATIONS AND PRELIMINARY DISCUSSION,

Tokai Univ., Shizouka (Japan). Faculty of Marine Science and Technology.
Y. Mazda.
Journal of the Oceanographical Society of Japan, Vol. 41, No. 4, p 225-234, September 1985, 13 fig, 1 tab, 22 ref.

Descriptors: *Tidal currents, *Model studies, *Bays, Tidal effects, Water currents, Density stratification, Seasonal variation.

For a vertical two-dimensional field with a sill at a bay entrance, the tidal exchange mechanism is discussed. A schematic model is proposed as follows: the tidal trapping effect which is detected at the entrance section, i.e., the material transport due to the phase difference between the tidal periodic constituent of material concentration and tidal current at the entrance section, results because the oscillatory tidal flow at the sill entrance induces a gravitational flow along the sill slope inside the entrance. Accordingly, the tidal trapping effect depends largely upon the difference in water density between the bay and open sea and the density stratification in the bay. This model is supported by observations at Kabira Cove (Okinawa) and Lake Hamana (Shizuoka) in 1976 through 1984. In addition, based on this model, in the case of Lake Hamana, the activity of the tidal exchange is inferred to change seasonally. (Master-PTT)
W86-05816

NOTE ON THE CHARACTERIZATION OF AN ESTUARINE MICROBIAL COMMUNITY ENRICHED WITH THE HERBICIDE FENURON,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5B.
W86-05939

EROSION OF SOFT COHESIVE SEDIMENT DEPOSITS,

Central Water and Power Research Station, Poona (India).
For primary bibliographic entry see Field 2J.
W86-05969

TWO-DIMENSIONAL PARTICLE TRACKING ESTUARINE TRANSPORT MODEL,

Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-06012

EFFECTS OF SALINITY ON PREFERRED AND LETHAL TEMPERATURES OF THE MOZAMBIQUE TILAPIA, OREOCHROMIS MOSSAMBICUS (PETERS),

Pennsylvania State Univ., University Park. Dept. of Fishery Science.
For primary bibliographic entry see Field 5C.
W86-06014

FEEDING RELATIONSHIPS BETWEEN THE BENTHIC INFAUNA AND THE DOMINANT BENTHIC FISH OF THE RANCE ESTUARY (FRANCE),

Museume National d'Histoire Naturelle, Dinard (France). Lab. Maritime.
P. Le Mao.
Journal of the Marine Biological Association of the United Kingdom JMBAAK, Vol. 66, No. 2, p 391-401, May 1986. 3 fig, 3 tab, 37 ref.

Descriptors: *Food habits, *Estuaries, *Food chains, *Predation, *Fish food organisms, *Benthic fauna, *Rance estuary, *Polychaetes, *Mollusks, France, Copepods, Amphipods, Decapods, Plaice, Sole, Mortality, Tidal powerplants, Reproduction, Stability.

Callionymus lyra, Pomatoschistus minutus, O-group Pleuronectes platessa, and O-group Solea vulgaris are the most abundant benthic fishes in the Rance Estuary. They feed mostly on polychaetes and bivalves, especially Ampharete acutifrons, Pygospio elegans, Cerastoderma sp., and Abra tenuis. Crusaceans (copepods, amphipods, and young decapods) are only secondary prey. An active competition exists between the four species of fish for Ampharete acutifrons and between young plaice and sole for Cerastoderma sp. The massive mortality of juveniles of these two prey species is attributed mainly to a severe over-exploitation by predators. Four dominant infaunal species, equivalent to 72% of the mean annual biomass of the community are almost totally ignored by benthic fishes. The resulting community equilibrium is closely dependent on the successful recruitment of only two prey species which have low life expectancy. The maintenance of stable ecological conditions, closely dependent on the mode of exploitation of the tidal power station is thus essential to avoid disturbing the recruitment of the main prey and to maintain this fragile balance. (Author's abstract)
W86-06030

BASS NURSERIES ON THE WEST COAST OF THE U.K.,

D. Kelley.
Journal of the Marine Biological Association of the

United Kingdom JMBAAK, Vol. 66, No. 2, p 439-464, May 1986. 4 fig, 5 tab, 23 ref, append.

Descriptors: *Bass, *Fish nurseries, *Estuarine fisheries, *Wales, *Estuaries, *Reproduction, *Sandbars, Hayle, Camel, Taw/Torridge, Nyfern, Teifi, Dyfi, Mawddach, Dwyryd/Glaslyn, Severn, Pollution, Estuary size, Age classes, Fisheries.

A survey was made in 1982-83 of eight shallow sand-bar type estuaries of the western United Kingdom coast not recognized previously as nurseries of bass, Dicentrarchus labrax (L.); they were Hayle, Camel, Taw/Torridge, Nyfern, Teifi, Dyfi, Mawddach, and Dwyryd/Glaslyn. All were found to be supporting populations of O-group bass. Taken with existing records for the south and southeast coasts of the Severn Estuary, the results indicated that all estuaries in the summer range of the species - roughly, the coastal waters west of a line Cumbria/East Anglia - are, if not polluted, likely to be nurseries for young bass, in degree probably related to estuary size. Sampling was done in the shallow creeks, marsh pools, and tributary streams. The best sites and most suitable measures of catch per unit effort were identified. Seasonal behavior and movements were noted, together with some possible sources of avoidable loss. Growth of the O-group bass differed in two respects from that of older bass. There were appreciable and consistent regional differences in growth-rates, and some growth occurred in winter - though at a much reduced rate. Scales had in no cases attained their full size, relative to body-size, by age 1, but appeared likely to do so by age 2. The 1982 brood appeared to be a very strong one, whereas that of 1983 appeared moderately strong. (Author's abstract)
W86-06031

CIRCULATION DYNAMICS IN THE DERWENT ESTUARY,

Department of Sea Fisheries, Taroona (Australia). Research and Resource Labs.
J. D. Thomson, and J. S. Godfrey.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 36, No. 6, p 765-772, December 1985. 4 fig, 15 ref.

Descriptors: *Estuaries, *Water circulation, Saline water intrusion, Saline-freshwater interfaces, Wind, Mixing, Entrainment, Australia.

This paper identifies the physical processes causing the mixing and circulation of water in the Derwent estuary from New Norfolk to the Tasman Bridge, and to give approximate quantitative rules governing the strengths of these processes. For moderate river discharges the Derwent estuary is strongly stratified in its upstream reaches; however, salt water is flushed completely as far downstream as Bridgewater, for river discharges greater than about 150 cubic meters per second. Salinity returns to normal in this section within about 10-20 days of a rainstorm. The main mixing mechanism appears to be surface stirring by the wind; a semi-empirical formula for wind-driven entrainment velocity gives values a factor about 1.5 times too small, but this may be due to a number of sources of observational error. Tidal mixing is detectable in the upstream Derwent, but is small compared to wind mixing in terms of induced vertical flows. (Author's abstract)
W86-06126

METHODOLOGY FOR ESTIMATING NUMBERS OF FREE-LIVING AND ATTACHED BACTERIA IN ESTUARINE WATER,

Institute for Marine Environmental Research, Plymouth (England).
K. R. Clarke, and I. R. Joint.
Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 5, p 1110-1120, May, 1986. 8 fig, 2 tab, 22 ref, append.

Descriptors: *Aquatic bacteria, *Estuaries, *Suspended solids, *Marine sediments, *Fluorescence, Microscopic analysis, Mathematical studies, Turbidity, Microbiological studies, Probability distribution, Tamar estuary, *England.

A fundamental problem in estuarine microbiology studies is the accurate determination of the density in the water column of both free-living bacteria and those attached to the suspended particulate matter. When a sample is filtered and the filter is viewed by epifluorescence microscopy, counts can be made of the numbers of bacteria which are seen on the filter background (free-living) and those which appear to lie on sediment particles (both free-living and attached). With only the additional knowledge of the proportion of the filter area covered by particles (a quantity that is straightforwardly determined by stereological point counting), results from geometric probability were used to determine the expected number of bacteria which are hidden by particles and hence to provide an estimation scheme for the true densities of free-living and attached bacteria. Variance equations based on a Taylor series are given, and a partial check of the method is attempted with a controlled mixtures of bacteria and sediment. An alternative procedure is also proposed, in which the natural attached/free-living ratio is altered by an intervention experiment, allowing an estimation which is less model dependent but more labor intensive. Both methods are applied to a series of samples from the Tamar estuary, United Kingdom, taken in April, 1985. A notable conclusion is that there are always more free-living than attached bacteria in the water column throughout the estuary. (Author's abstract)
W86-06139

EXTRACELLULAR ORGANIC CARBON (EOC) RELEASED BY PHYTOPLANKTON AND BACTERIAL PRODUCTION,

Aarhus Univ. (Denmark). Botanical Inst.
For primary bibliographic entry see Field 2H.
W86-06141

PATHS OF THE SUSPENDED PARTICULATE INORGANIC AND ORGANIC MATTER IN A SMALL URBAN ESTUARY. THE AARHUS HARBOUR ESTUARY,

Aarhus Univ. (Denmark). Lab. of Geomorphology.
For primary bibliographic entry see Field 5B.
W86-06165

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALINATION PLANT IS BASIS FOR 1300 MW OF COGENERATED POWER,

Stearns Catalytic World Corp., Denver, CO.
C. N. Fohner.
Power Engineering, Vol. 89, No. 8, p 38-41, Aug. 1985. 2 fig.

Descriptors: *Cogenerated power, *Desalination, *Desalination plants, Electric powerplants, Saudi Arabia, Dual-purpose plants.

A dual-purpose desalination-power plant provides up to 210 million gallons per day of fresh water and 1300 megawatts of electric power. The plant, which is located on the Persian Gulf, was built between 1978 and 1984 by Saudi, Japanese, French and Italian contractors. The multistage flash evaporator units use polyphosphate as a scale control additive. In order to achieve the specified 210 million gpd water production, 40 evaporator units, each rated at 6.24 million gpd, were required, with a planned availability of 34 units (85%) on line. The plant has 20 seawater intake pumps, each 110,000 gpm capacity, housed in four intake structures. A seawater chlorination facility is adjacent to each intake structure. The product water is passivated with lime and disinfected with chlorine at a product water treatment complex. (Jones-PTT)
W86-05862

POSTTREATMENT OF REVERSE OSMOSIS PRODUCT WATERS,

Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
For primary bibliographic entry see Field 5D.
W86-06059

EVAPORATION OF VOLATILE-LIQUID LENSES FLOATING ON AN IMMISCIBLE-LIQUID SURFACE: EFFECTS OF THE SURFACE AGE AND FLUID PURITIES IN N-PENTANE/WATER SYSTEM,

Keio Univ., Yokohama (Japan). Dept. of Mechanical Engineering.
T. Nosoko, T. Ohyama, and Y. H. Mori.
Journal of Fluid Mechanics JFLSA7, Vol. 161, p 329-346, December 1985. 12 fig, 15 ref. Ministry of Education, Science and Culture of Japan Grant No. 59550160.

Descriptors: *Volatility, *Evaporation, *Hydrocarbons, *Evaporators, Fluid mechanics, Temperature effects, Theoretical analysis, Pentane.

Described is a fundamental study of evaporation of the volatile-liquid lenses due to the heat supply from the substrate of an immiscible, less-volatile liquid under the atmosphere of the common vapors of the two fluid substances. This type of problem has a practical importance in relation to one type of direct-contact evaporator, which then has potential applications in water desalination units, geothermal-heat-recover systems and waste-heat-recovery systems. Experiments were performed with single n-pentane lenses placed on the surface of an otherwise quiescent pool of water. The behavior of each lens throughout its life was monitored in detail by laser shadowgraphy. Results showed that the time required for complete evaporation of each lens, and the behavior of the lenses, change in a peculiar but regular way, with the age of the water surface. This aging effect is more significant when fluids of higher purities are used, and is thought to be due to the quantity of contaminants at the surface increasing with its age. (Geiger-PTT)
W86-06146

3B. Water Yield Improvement

FURTHER ASSESSMENT OF TREATMENT EFFECTS IN THE FLORIDA AREA CUMULUS EXPERIMENT THROUGH GUIDED LINEAR MODELING,

Cooperative Inst. for Research in Environmental Science, Boulder, CO.
J. A. Flueck, W. L. Woodley, A. G. Barnston, and T. J. Brown.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 4, p 546-564, April 1986. 7 tab, 21 ref.

Descriptors: *Cloud seeding, *Rainfall, *Statistical methods, Florida area cumulus experiment, Statistical models, Convective precipitation, Model studies.

Whether further information on the potential treatment effects in the Florida Area Cumulus Experiment (FACE) program could be obtained was investigated by utilizing a guided exploratory approach to linearly modeling the target area rainfall in the FACE program. A predictive statistical linear model of the FACE-2 rainfall and the potential treatment effects was built. This form was also applied to the FACE-1 data. The replication of the treatment effect in the two separate stages of FACE was investigated. Two approaches were taken to assessing the treatment effects in FACE-1 and in FACE-2: cross-comparison and cross-validation. Both techniques suggest a positive treatment effect in each stae of FACE. The conventional 0.05 adjusted statistical level of support was only present in the FACE-1 data. The question of whether FACE-1 results were different from FACE-2 was unresolved. These results continue to emphasize the need to account for the natural convective precipitation processes in south Florida prior to conducting a cloud seeding project. (Peters-PTT)
W86-05460

ATMOSPHERIC WATER BALANCE OVER A MOUNTAIN BARRIER,
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 2B.
W86-05474

SPECIAL REMARKS ON HYDRO POTENTIAL FOR MINI POWER DEVELOPMENTS,
For primary bibliographic entry see Field 8C.
W86-05735

1980-81 DROUGHT IN SOUTHEASTERN NEW YORK,
State Univ. of New York at Albany. Dept. of Atmospheric Science.
R. A. Weisman.
American Meteorological Society Bulletin, Vol. 66, No. 7, p 788-794, July 1985. 8 fig, 1 tab, 5 ref.

Descriptors: *Water consumption, *Moisture balance, *Water deficit, *Drought, *New York City, Drinking water, Regional planning, Storage reservoirs.

In southeastern New York during 1980 and early 1981, precipitation and moisture budget calculations indicated that a net water deficit existed, but it was not severe enough to warrant the drought warning that was issued. The storage in the New York City reservoir system did drop and water shortages were severe. Examination of New York City water-consumption levels over the previous 40 years indicated an increase in the 1970s, which made the system less able to withstand the moderate dry spell. The water system had become dependent on above-normal rainfall to remain stable. The water system had become dependent on above-normal rainfall to remain stable. Effective regional planning is necessary to ensure a continuous flow of drinking water to the city. (Adams-PTT)
W86-05831

3C. Use Of Water Of Impaired Quality

DRINKING WASTEWATER,
B. Nydes.
American City & County, Vol. 100, No. 9, p 52-54, 56, 58, 60, September 1985.

Descriptors: *Reclaimed water, *Water reuse, *Wastewater treatment, *Drinking water, *Treated water, Water supply, Effluents, Water, Economic aspects, Potable water, Denver, Colorado, Tampa, Florida, Water treatment.

Wastewater recycling for agricultural and other reuse has been practiced for more than 2,000 years; however, scientists now are considering advanced treatment of municipal effluents to meet existing and projected shortages of US drinking water supplies. Natural arid conditions and population shifts south and west are cited as prime factors in creating scarcity. Tampa, Florida is now planning a 20-year project to recharge and augment surface water supplies used for potable water, and Denver, Colorado is now operating a seven-year direct potable reuse demonstration project. It is estimated that less than 2% of all American wastewater reclamation projects aim at direct potable reuse, since health and regulatory authorities want to be absolutely sure of safety and water quality values. Meanwhile, in addition to augmentation of water supplies, wastewater reclamation has a major pollution abatement benefit, and may also encourage economic growth in a region. The cost of full-scale potable reuse projects may be less than that of developing new water sources by 1995. (Doria-PTT)
W86-05929

NATIONAL AND INTERNATIONAL IMPORTANCE OF DROUGHT AND SALINITY EFFECTS ON AGRICULTURAL PRODUCTION,
Australian Centre for International Agricultural Research, Canberra (Australia).
J. R. McWilliam.
Australian Journal of Plant Physiology, Vol. 13, No. 1, p 1-13, 1986. 2 tab, 9 fig, 26 ref.

Descriptors: *Drought, *Salinity, *Crop production, Semiarid lands, Humid areas, Water stress, Irrigation practices, Agriculture.

The impact of drought and salinity on agricultural production in both the semiarid and humid regions of the world is reviewed. The frequency and nature of drought events and some recent approaches to drought prediction are discussed along with the distribution of salinity and the various factors leading to its occurrence under both irrigated and dryland conditions. Strategies to minimize the impact of drought and salinity on the rural community and on the stability of land resources have been developed largely in high-income countries. However, because of the high cost, little has been done in the developing world where extensive areas of valuable land are deteriorating, representing a serious threat to food security. The impact of drought and salinity on agricultural production is hard to quantify as water stress, high temperature, poor irrigation practice and over exploitation of land, all interact to reduce food production. Investment in agricultural infrastructure, including irrigation and improved technology, management and more tolerant crop varieties are required to help improve and stabilize agricultural production. The investment will provide the basis for more effective strategies to manage these two major problems that will remain as long as man continues to practice conventional field-based agricultural production. (Peters-PTT)
W86-05954

WHOLE-PLANT CARBON BALANCE DURING OSMOTIC ADJUSTMENT TO DROUGHT AND SALINITY STRESS,
For primary bibliographic entry see Field 2I.
W86-05955

METABOLIC EFFECTS OF WATER AND SALINITY STRESS IN RELATION TO EXPANSION OF THE LEAF SURFACE,
Waite Agricultural Research Inst., Glen Osmond (Australia). Dept. of Plant Physiology.
For primary bibliographic entry see Field 2I.
W86-05956

ION RELATIONS OF PLANTS UNDER DROUGHT AND SALINITY,
Sussex Univ., Brighton (England). School of Biological Sciences.
For primary bibliographic entry see Field 2I.
W86-05957

WHOLE-PLANT RESPONSES TO SALINITY,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
For primary bibliographic entry see Field 2I.
W86-05959

SALINITY RESISTANCE IN RICE (ORYZA SATIVA L.) AND A PYRAMIDING APPROACH TO BREEDING VARIETIES FOR SALINE SOILS,
Sussex Univ., Brighton (England). School of Biological Sciences.
A. R. Yeo, and T. J. Flowers.
Australian Journal Plant Physiology, Vol. 13, No. 1, p 161-173, 1986. 6 tab, 3 fig, 36 ref.

Descriptors: *Salinity, *Rice, *Salt tolerance, Hybridizations, Agronomy, Growth, Survival, Toxicity, Leaves, Plant physiology.

A need exists to develop salinity-resistant varieties of rice. Mass screening of the 70,000 varieties currently exist to identify those with natural salt resistance has led to hybridizations in which some of the salt tolerance of traditional varieties has been combined with other desirable agronomic characteristics of the more modern varieties. The gross uptake of Na(+) is poorly correlated with growth and survival because net transport interacts with vigor and degree of dwarfing and because NaCl is compartmentalized within the plant confounding any simple relationship between tissue concentration, growth reduction and toxicity symptoms. Resistance is conferred by no single factor, but is the sum of a number of contributory traits which include variations in NaCl entry via membrane leakage or apoplastic pathways; preferential accumulation of Na(+) in the older leaves; and tolerance of NaCl within the leaf tissue which may reflect differences in apoplastic salt load. It is suggested that the salt resistance of rice can be increased by selecting separately for such physiology traits and then pyramiding them together. (Peters-PTT)
W86-05960

CHANGES IN THE TOTAL ALKALOID CONTENT OF DATURA INNOXIA MILL. SUBJECTED TO SALT STRESS,
Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Lab. du Phytotron.
For primary bibliographic entry see Field 2I.
W86-06032

RECLAIMED CALIFORNIA WASTEWATER PROVIDES DROUGHT INSURANCE,
Moulton Niguel Water District, Laguna Niguel, CA.
J. V. Foley, R. Miller, and G. A. Garzonetti.
Water/Engineering and Management WENMD2, Vol. 133, No. 5, p 30-31, May 1986.

Descriptors: *Reclaimed water, *Irrigation water, *Tertiary wastewater treatment, *California, Golf courses, Parks, Greenbelts, Chemical coagulation, Alum, Sedimentation, Chlorination, Potable water, Costs.

Wastewater reclamation is providing an economical, uninterruptible supply of irrigation water to golf courses, parks, and greenbelt areas in southern Orange County, California, as a result of projects undertaken by the South Coast County Water District and the Moulton Niguel Water District. Both projects use alum for coagulation and sedimentation, and provide chlorine contact for the 2-hr period required to meet state regulations. Tertiary filtration to meet the turbidity standards is provided by pulsed-bed rapid sand filters. Revenues from the sale of reclaimed water will pay for the South Coast County District's share of the tertiary treatment plant costs. A backup system can supply potable water to irrigators in case of any treatment plant problems that might make reclaimed water temporarily unavailable. The combination of lower costs and the promise of an uninterruptible supply, even during severe drought, has made reclaimed water extremely attractive to irrigators. (Rochester-PTT)
W86-06040

CONTAMINATION AND GROWTH OF THE SHRIMP, PENAEUS STYLIROSTRIS STIMPSON, CULTURED IN A SEAWATER/WASTEWATER AQUACULTURE SYSTEM,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
M. Landau, R. H. Pierce, L. D. Williams, and D. R. Norris.
Bulletin of Environmental Contamination and Toxicology BECTAG, Vol. 35, No. 4, p 537-545, October, 1985. 2 tab, 25 ref, NSF Grant No. DAR 8023060.

Descriptors: *Wastewater reuse, *Wastewater treatment, *Aquaculture, *Shrimp, Growth rate, Gas chromatgraphy, Heavy metals, Organic compounds, Phenols, Copper, Cadmium.

One of the most significant costs of mariculture operations is feed. Costs of culturing marine animals could be lowered by reducing the stocking densities used in the ponds and substituting nutrient rich treated wastewater for commercial feeds. However, the animals in an aquaculture system based on wastewater may be subject to contamination. The growth of shrimp cultured in wastewater

was monitored. Water and tissue samples were analyzed for organic and inorganic contaminants. Two ponds received effluent and two others were fed commercial food. Two of the four ponds were low density cultures and the remaining two were stocked for high density. After five months shrimp were harvested, counted, and subsampled. Samples were analyzed by gas chromatography and high pressure liquid chromatography. Phenols and polynuclear aromatic hydrocarbons (PAHs) were detected at a UV wavelength of 254 nm. Water and tissue samples were analyzed for heavy metals with an absorption spectrophotometer. P. stylirostris grown in low density cultures were significantly larger than those grown in high density. Ponds with wastewater consistently had lower salinities than those without. Water samples generally contained <10 micrograms/L PAH and phenol compounds. Hydrocarbon extracts of the shrimp samples were indicative of biogenic material. There were no major differences between the control ponds and test ponds receiving wastewater. High levels of Cu were detected. Cadmium may have been concentrated by shrimp in the effluent treated ponds, and selenium was found in higher titers in small shrimp. The biomass produced by shrimp whose only nutrient source is wastewater is less than that when a commercial feed is used. Stocking density was inversely proportional to the mean weight of the shrimp. Low metal values may be a result of loss by filtration, and high Cu levels may be from antifouling paints from vessels in the ship canal. (Main-PTT)
W86-06071

HEALTH RISKS ASSOCIATED WITH WASTEWATER IRRIGATION: AN EPIDEMIOLOGICAL STUDY,
Hebrew Univ. of Jerusalem (Israel). School of Public Health.
For primary bibliographic entry see Field 5C.
W86-06079

ENVIRONMENTAL MOVEMENT OF INDICATOR BACTERIA FROM SOIL AMENDED WITH UNDIGESTED SEWAGE SLUDGE,
Oklahoma Univ. Health Sciences Center, Oklahoma City.
For primary bibliographic entry see Field 5B.
W86-06083

FERTILIZATION MANAGEMENT OF CROPS IRRIGATED WITH SALINE WATER,
Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
A. Feigin.
Plant and Soil PLSOA2, Vol. 89, No. 1-3, p. 285-299, 1985. 4 fig, 37 ref.

Descriptors: *Irrigation practices, *Soil fertility, *Irrigation effects, *Saline water, *Impaired water use, Salinity, Path of pollutants, Sodium, Calcium, Chlorides, Bicarbonates, Sulfates, Boron, Soil contamination, Nitrogen, Potassium, Phosporus, Magnesium, Sulfur.

The concentration of various ions in the root zone of plants determines both salinity and soil fertility. Salinity develops when the concentrations of Na, Mg, Ca, Cl, HCO3, SO4 ions and B in the soil solution is high enough to affect plant growth. As the salt concentration exceeds a threshold level, the growth rate and final size of plants progressively decreases along with the crop yield. Studies conclude that the effect of salinity on plants is a result of two factors: restriction of water uptake by high osmotic potentials in the soil, and high concentration of specific ions that may cause physiological disorders in plant tissues. The level of soil fertility is determined by the level of available nutrient elements (N, P, K, Ca, Mg, S and micronutrients). The availability of N, P and K in soils is often too low for economic yields of agricultural crops. The addition of fertilizers to maintain an adequate fertility level is therefore a standard practice in agricultural soils. The concentration of other nutrient elements is rarely below the desirable level, although these materials may be applied in standard fertilizers or under specific situations. (David-PTT)
W86-06089

WATER RELATIONS OF THE DUNE GRASSES AMMOPHILA ARENARIA AND ELYMUS MOLLIS ON THE COAST OF OREGON, USA,
Iowa State Univ., Ames. Dept. of Botany.
For primary bibliographic entry see Field 2I.
W86-06140

3D. Conservation In Domestic and Municipal Use

EFFICIENCY OF WATER PRICING: A RATE OF RETURN ANALYSIS FOR MUNICIPAL WATER DEPARTMENTS,
California Univ., Santa Barbara. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W86-06024

3E. Conservation In Industry

CONCEPTUAL PLAN FOR WATER MANAGEMENT SCHEMES IN THE NORTHERN PART OF THE RHENISH LIGNITE MINING DISTRICT,
Rheinische Braunkohlenwerke A.G., Cologne (Germany, F.R.).
B. Boehm.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 571-579, 2 fig, 4 ref.

Descriptors: *Groundwater management, *Dewatering, *Water demand, *Lignite mining, *Conceptual planning, *West Germany, Groundwater pollution, Groundwater withdrawal, Management planning, Industrial water, Water management.

Lignite mining in the Rhenish district is, for technical reasons, only possible using opencast methods. Opencast mines are dewatered by a large number of wells which are arranged around and within the individual mining fields. In 1981, Rheinbraun AG lifted about 1.2 billion cu m of ground water from these wells to mine some 119 million metric tons of lignite. Of this quantity the Frimmersdorf/Garzweiler opencast mine in the northern part of the mining area discharged for 35 million metric tons of lignite about 90 million cu m of water in 1981. In the last few years, the extensions to the well fields have resulted in a growth of the cone of depression far beyond the mining sites. The cone has extended into an area already affected by substantial withdrawals of ground water by local industry. To limit these adverse effects, a conceptual plan for water management schemes was devised by the district government and Rheinbraun AG. This plan involved: further development of the water management data, assuring a long-term water supply to the public and industrial sectors, measures to again attain a base and minimum flow in gaining streams, and preservation of regional wetlands. (See also W86-05679) (Lantz-PTT)
W86-05681

ZERO DISCHARGE WATER TREATMENT DESIGN HAS HIGH RELIABILITY,
Burns and McDonnell, Kansas City, MO.
For primary bibliographic entry see Field 5D.
W86-05863

3F. Conservation In Agriculture

COMPLEX EFFECT OF SOME AGRONOMICAL PROCEDURES AND HYDROMETEOROLOGICAL FACTORS ON THE WATER BUDGET OF THE SOIL,
Debrecen Univ. of Agrarian Sciences (Hungary).
L. Ruzsanyi, and G. Szasz.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 619-634, 5 fig, 1 tab.

Descriptors: *Agronomy, *Soil water, *Hydrologic budget, *Hydrometeorology, Irrigation, Fertilization, Sowing, Water use, Cropland.

In order to find ways of exploiting natural resources to a greater extent a study was conducted to determine how the disposition of the sown area, fertilization, irrigation and various hydrometeorological factors affect the water budget of the soil. Based on the results of small-plot field experiments going on for the past 12 yrs as well as on observations of several decades made by the Agrometeorological Observatory of the Agricultural University of Debrecen, the following conclusions were drawn (1) In view of the present problems of energy management all around the world endeavors should be made to utilize natural water supplies at the site of crop production as efficiently as possible; (2) Rainfall is one of the major factors influencing the time change of the water supply of the site. Changes in the moisture resources of the 0-200 cm upper layer of the soil are related to the amount and deviation in time of the rainfall; (3) As a result of differences in the water consumption of the various plants, the moisture content of soils of plants of high, moderate and low water requirements can vary greatly at the end of the vegetative period. When evaluating the after-effects of these crops, it is important to remember that it is not so much in the upper layers but rather in the lower (100-200 cm) lying layers that differences can be found in the moisture content of the soil; and (4) Fertilization increases the water consumption of various plants to various degrees. Excessive water consumption varies between 20-80 millimeters and is consistently reflected in soil moisture profiles. (See also W86-05679) (Author's abstract)
W86-05685

MULTIPURPOSE USE OF WATER RESOURCES IN IRRIGATION SYSTEMS,
State Office for Technical Development, Budapest (Hungary).
L. David.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 225-233, 4 fig, 1 tab, 14 ref.

Descriptors: *Planning, *Water use, *Water demand, *Irrigation, *Water allocation, Model studies, Mathematical models, Water management, Multipurpose project, Competing use.

The purpose of this paper is to estimate the water resources available for other users in supplementary irrigation systems and to describe the constraints of this multipurpose use. Based on the problem description, a mathematical model is presented to characterize the water demand or irrigation systems under supplementary conditions by a system of distribution and other functions. The available but unused water resources in the irrigation system, can be determined by the comparison of irrigation water demand described by the mathematical model, the capacity of the irrigation system, the usable water resources, and the limit. The possibilities and constraints on the use of these water resources for domestic and industrial water supply, for water quality management and for other purposes are discussed with examples of application of the methodology. Finally, some conclusions and recommendations are summarized for the planning of basinwide allocation of resources. (see also W86-05750) (Author's abstract)
W86-05772

REAL TIME MANAGEMENT OF WATER RESOURCES IN LOW RAINFALL AREAS,
Indian Inst. of Tech., New Delhi. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W86-05782

DISTRIBUTED CONJUNCTIVE USE MODEL FOR OPTIMAL CROPPING PATTERN,

Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 4B.
W86-05786

PROCEDURE TO SELECT AN OPTIMUM IRRIGATION METHOD,

Concepcion Univ. (Chile). Dept. of Agricultural Engineering.
E. A. Holzapfel, M. A. Marino, and J. Chavez-Morales.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 111, No. 4, p 319-329, December 1985. 10 fig, 3 tab, 10 ref. Agricultural Research Service Agreement No. 4350-H.

Descriptors: *Irrigation design, *Irrigation practices, *Cost analysis, Planning, Evaluation, Economic aspects, Irrigation, Crop density, Diseases, Growth, Infiltration, Slopes, Water quality, Labor.

Selection of the best irrigation method is based on feasibility indices, cost, and financial feasibility criteria, to best meet the existing conditions. The indices (crop density, disease, growth, infiltration, slope, water quality, and labor skill) were selected on the basis of factors that affect the selection of the irrigation systems, showing the degree of acceptability of the irrigation methods to the selection parameters. The indices were used in a multiplicative manner to rank the irrigation methods. Those methods with a zero final value are not suitable to irrigate the field and are excluded. The final selection of an irrigation method is based on economic and financial analysis. (Doria-PTT)
W86-05916

LEAST-COST PLANNING OF IRRIGATION SYSTEMS,

Auburn Univ., AL. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 6B.
W86-05919

DIMENSIONLESS FORMULATION OF FURROW IRRIGATION,

T. Strelkoff.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 111, No. 4, p 380-394, December 1985. 1 tab, 13 ref. Agricultural Research Service Contract No. 53-9AHZ-1-1685.

Descriptors: *Furrow Irrigation, *Flow Discharge, *Irrigation Design, Mathematical Models, Irrigation Engineering, Irrigation, Mathematical analysis.

The equations governing the flow of water in irrigation furrows are put in nondimensional forms by expressing each variable in the ratio to an appropriate reference variable. Two systems of reference variables are considered, one based on normal depth in the given furrow geometry at the given inflow, the other on the given inflow and cutoff time. The first is especially valuable because of the clear physical significance of normal depth, but it is useless in horizontal furrows. The second system is useful for furrows set on any slope. The matter of choosing a system of reference variables is viewed in general terms, to allow application to other systems suitable for special applications, in particular, design applications. A set of formulae is presented for translation from one system to the other. The necessary input for a completely nondimensional treatment of furrow irrigation is outlined, and the concept of hypothetical dimensioned furrows is introduced. This is designed to provide a physical significance to variables entered in dimensionless form as input to a mathematical model of furrow irrigation. (Doria-PTT)
W86-05921

BRINK DEPTH IN NONAERATED OVERFALLS,

National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W86-05922

SURFACE IRRIGATION OPTIMIZATION MODELS,

Concepcion Univ. (Chile). Dept. of Agricultural Engineering.
E. A. Holzapfel, M. A. Marino, and J. Chavez-Morales.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 1, p 1-19, February 1986. 2 fig, 9 tab, 22 ref. Agricultural Research Service Cooperative Agreement No. 4350-H.

Descriptors: *Surface irrigation, *Model studies, *Optimization, *Irrigation design, Computer programs, Computer models, Cutoffs, Water supply.

This paper presents furrow and border irrigation design optimization models for corn. The models, which have nonlinear objective functions and constraints, are linearized to take advantage of existing linear programming codes that perform sensitivity analysis and can be run in microcomputers. The models give the optimal values of the design variables (inflow discharge, length of the run, time of irrigation cutoff, and width of border for border irrigation). Field data are used to obtain solutions to the models. Results indicate that the timing of irrigation cutoff is the most critical design variable. Water supply and time available for irrigation are also important factors to be considered in the design process. (Doria-PTT)
W86-05923

DISCHARGE CHARACTERISTICS OF FLOW PAST A FLOOR SLOT,

Concordia Univ., Sir George Williams Campus, Montreal (Quebec). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W86-05924

STOCHASTIC MODELING OF IRRIGATION REQUIREMENTS,

Central Soil Salinity Research Inst., Karnal (India).
R. K. Gupta, and H. S. Chauhan.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 1, p 65-75, February 1986. 5 fig, 6 tab, 9 ref.

Descriptors: *Model studies, *Irrigation requirements, *Irrigation design, *Stochastic hydrology, Crop production, Statistical analysis, Hydraulic models, Fourier analysis.

The stochastic structure of the weekly irrigation requirements of a crop was studied. Irrigation requirement time series was assumed to be represented by an additive model with trend, periodic and stochastic components. Each component was identified and, if found, removed from the original series. The turning point test and Kendall's rank correlation test were applied to detecting any trend. In the analysis of series, the correlogram technique was used to detect the periodicity, which was then analyzed by the Fourier series method. Harmonic analysis is done for identifying the number of significant harmonics. The series was tested for stationarity and the dependent part of the stochastic component was be well expressed by the second order autoregressive model. Therefore, as a result, the developed model superposes a periodic-deterministic process and a stochastic component. The adequacy of fit was judged by the insignificant correlation and normal distribution of the obtained residuals. The developed periodic-stochastic model may be used for representing the time based structure of the irrigation requirement time series of a paddy crop. (Doria-PTT)
W86-05928

PAYING FOR WATER,

For primary bibliographic entry see Field 6E.
W86-05951

RESISTANCE TO DROUGHT AND SALINITY: AVENUES FOR IMPROVEMENT,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
J. B. Passioura.
Australian Journal Plant Physiology, Vol. 13, No. 1, p 191-201. 1 fig, 47 ref.

Descriptors: *Drought, *Salinity, *Agronomy, Grains, Water supply, Wheat, Rainfall, Groundwater, Plant physiology, Crop production.

Various techniques for improving the resistance of plants to drought or salinity are discussed in relation to a notional spectrum ranging from rationality to random search. Drought occurs in many ways, but there are a few fairly distinct and useful patterns. In one, the crop relies predominantly on current rainfall. In a second, the crop relies predominantly on a store of water accumulated in the soil during a fallow. The rational end of the spectrum is exemplified by the control of phenology so that flowering occurs at an optimal time; the random end by wide crosses, such as that between wheat and elytrigia, which give the remote hope that the high yield potential of one will combine with the toughness of the other. Most of the techniques occupy the middle ground and involve selecting for characters whose protagonists have strong, but often poorly articulated, hunches that the characters will confer resistance to drought or salinity on the plants possessing them. For drought resistance of grain crops, the possible worth of many of these characters is discussed in relation to their likely impact on improving a crop's ability to extract water from the soil, to produce dry matter given a limited water supply, and to convert dry matter into grain. (Peters-PTT)
W86-05962

WATER TRANSFER BY PLANT ROOTS FROM WET TO DRY SOIL,

Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 2D.
W86-05964

SEDIMENT TRANSPORT IN SHALLOW FLOWS,

Clemson Univ., SC.
For primary bibliographic entry see Field 2J.
W86-05970

NONDESTRUCTIVE OBSERVATIONS OF SOLUTION DISPLACEMENT IN SOILS,

California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 2G.
W86-06008

ECONOMIC EVALUATION OF ON-FARM WATER MANAGEMENT PROJECTS,

Colorado State Univ., Fort Collins. International School for Agricultural and Resource Development.
For primary bibliographic entry see Field 6C.
W86-06013

CHOICES OF IRRIGATION TECHNOLOGIES IN CALIFORNIA,

California Univ., Berkeley. Dept. of Agricultural and Resource Economics.
M. Caswell, and D. Zilberman.
American Journal of Agricultural Economics, Vol 67, No. 2, p. 224-234, May 1985. 3 tab, 15 ref.

Descriptors: *Irrigation practices, *California, *Water demand, Fruit Growers, Groundwater, Drip irrigation, Sprinkler irrigation, Groundwater depletion, Surface Irrigation.

In the Southwest, the recent increase in nonagricultural water demand, the constant decline in water reservoirs, and the slower pace (or sometimes freeze) in the development of new water projects emphasize the need for improved irrigation efficiency. Adoption and extensive use of technologies such as sprinkler and drip irrigation may be one avenue to attain this goal. The Central Valley of California is the premier tree-crop producing area in the nation and is the major beneficiary of existing water projects. This area suffers from severe groundwater overdraft problems, and

its agricultural economy is vulnerable to shortages in water supply. The diffusion of modern irrigation technologies is perceived as one way to reduce this vulnerability. Most of the past studies on selection of irrigation technologies tended to take an engineering approach, but this study takes an alternative approach: the use of econometric tools and actual data on adoption patterns to explain and predict parameters and factors affecting the diffusion of modern irrigation technologies in California. (David-PTT)
W86-06116

MESO-SCALE STUDY OF CROP DROUGHT CLIMATOLOGY OVER MAHARASHTRA,
Meteorological Office, Poona (India).
For primary bibliographic entry see Field 2B.
W86-06134

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

RISK ANALYSIS FOR RESERVOIR OPERATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
H. A. Loaiciga, and M. A. Marino.
Water Resources Research WRERAO, Vol. 22, No. 4, p 483-488, April 1986. 2 fig, 3 tab, 16 ref.

Descriptors: *Water management, *Planning, *Reservoir operation, *Economic aspects, Model studies, Hydroelectric power, Powerplants, Flood control, Decision making, Shasta Dam, California, Sacramento River, Water storage, Reservoir releases.

The planning of reservoir operation presents decision makers with a trade-off between competing functions, which are energy production and flood control in this study. To optimally resolve the trade-off between maximization of energy revenues and minimization of downstream losses, the interaction between the expected value and variance of revenues (accruing from the reservoir operation) is included in a stochastic daily reservoir operation planning model. By parametrically varying the expected value and variance of the objective function, the risk-averse nature of decision makers is incorporated, resulting in a range of feasible alternative policies that reflect the decision maker's attitude toward revenue maximization and poor performance of the reservoir operation. A set of feasible storage policies was derived and the corresponding trade-off curve between the expected revenue and the standard deviation of such revenues is given for the daily operation of Shasta reservoir in northern California. (Cassar-PTT)
W86-05428

PROGRAMMING MODEL FOR ANALYSIS OF THE RELIABILITY, RESILIENCE, AND VULNERABILITY OF A WATER SUPPLY RESERVOIR,
Corps of Engineers, Fort Belvoir, VA. Water Resources Center.
W. S. Moy, J. L. Cohon, and C. S. ReVelle.
Water Resources Research WRERAO, Vol. 22, No. 4, p 489-498, April, 1986. 8 fig, 2 tab, 25 ref.

Descriptors: *Water management, *Planning, *Reservoir operation, Reliability, Economic aspects, Risks, Model studies, Water storage, Reservoir releases, Multiobjective planning.

Two proposed descriptions of reservoir performance are explored: the maximum shortfall from the target (system vulnerability) and the maximum number of consecutive periods of deficits, the more resilient the system. Tradeoffs between reliability, vulnerability, and resilience are examined with multiobjective mixed-integer linear programming. An increase in vulnerability (the largest recorded deficit) is noted in a more reliable reservoir situation as well as in a more resilient (quick to recover) reservoir operation. (Cassar-PTT)
W86-05429

CHANCE-CONSTRAINED MODEL FOR REAL-TIME RESERVOIR OPERATION USING DROUGHT DURATION CURVE,
Yamanashi Univ., Kofu (Japan). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 2E.
W86-05435

LINEAR PROGRAMMING SCREENING MODEL FOR THE GRAND RIVER BASIN,
Ecologistics Ltd., Waterloo (Ontario).
For primary bibliographic entry see Field 6A.
W86-05471

RIVER RSPONSE TO DREDGING,
Resource Consultants, Inc., Fort Collins, CO.
For primary bibliographic entry see Field 8B.
W86-05499

HYDROLOGICAL ASPECTS OF ALPINE AND HIGH-MOUNTAIN AREAS.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2C.
W86-05610

WATER STORAGE AND DRAINAGE WITHIN THE FIRN OF A TEMPERATE GLACIER (VERNAGTFERNER, OETZTAL ALPS, AUSTRIA),
Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie.
For primary bibliographic entry see Field 2C.
W86-05618

LARGE-SCALE ASSESSMENT OF SNOW RESOURCES FOR FORECASTING SPRING FLOW,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 2C.
W86-05632

NATURAL DAMS AND OUTBURST FLOODS OF THE KARAKORAM HIMALAYA,
Wilfrid Laurier Univ., Waterloo (Ontario).
For primary bibliographic entry see Field 2C.
W86-05637

STUDY ON THE VARIATION COEFFICIENT OF ANNUAL RUNOFF OF THE RIVERS IN NORTHWEST CHINA,
Academia Sinica, Lanzhou (China). Lanzhou Inst. of Glaciology and Cryopedology.
L. Zuming.
IN: Hydrological Aspects of Alpine and High-Mountain Areas, IAHS Publication No. 138, 1982. Proceedings of a Symposium at the First Scientific General Assembly of the IAHS, July 19-30, 1982. Exeter, England. p 285-294, 3 fig, 3 tab, 4 ref.

Descriptors: *Glaciers, *Glaciohydrology, *Variation coefficient, *Runoff, *Discharge hydrographs, Alpine regions, Mountains, Hydrology, Hydrological aspects, Rivers, Statistical analysis.

The coefficient of variation (CV) of annual runoff of rivers is the main indication for the yearly variation in river runoff. The study of the variation of annual runoff CV of the rivers in northwest China is not only valuable for water conservancy projects and agriculture, but also for understanding the relationship between glacier ablation and river runoff, as well as for utilization of water resources from glacier-fed rivers. Therefore it is of definite significance in the domain of science. Starting with an analysis of the main factors, this study investigates the quantitative relationship between CV and other variables, the laws governing variation of CV with altitude, and its distribution features in rivers with different alimentations. (See also W86-05610) (Author's abstract)
W86-05639

WATER AND NUTRIENT DISCHARGE DURING SNOWMELT IN SUBALPINE AREAS,
Swiss Forest Research Inst., Birmensdorf.
For primary bibliographic entry see Field 2C.
W86-05643

CHANGE OF RUNOFF CHARACTERISTICS BY URBANIZATION,
National Research Center for Disaster Prevention, Sakura (Japan).
T. Kishii.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 107-110, 4 fig, 2 ref.

Descriptors: *Runoff, *Rainfall-runoff relationships, *Urban runoff, *Urbanization, *Surface runoff, Groundwater recharge, Infiltration, Geology, Rainfall, Land use, Catchment areas, Permeability, Rainfall infiltration, Storm runoff, Japan.

The groundwater and direct runoff components of runoff change due to urbanization. Therefore, it is expected that increases in the direct runoff induce decreases of rainfall loss and groundwater runoff. The change of the direct runoff was analyzed by use of the runoff parameters, such as runoff ratios and rainfall loss. In an attempt to estimate the change in total volume and rainfall loss, when a natural basin which consists mainly of mountains, forests and wastelands becomes urbanized, the runoff ratios and rainfall loss were compared between natural and urbanized basins in Japan. Both natural and urbanized basins are further divided into basins of high and low permeability, according to their surface geology. From these results, it is considered that, in urbanization the surface geology is basically an important factor in the runoff characteristics as distinct to the changes in land use which are relatively important. (See also W86-05645) (Author's abstract)
W86-05656

EVALUATION OF FLOOD-LEVEL PREDICTION USING ALLUVIAL-RIVER MODELS.
National Research Council, Washington, DC. Advisory Board on the Built Environment.
For primary bibliographic entry see Field 6F.
W86-05741

OPTIMAL ALLOCATION OF WATER RESOURCES.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 6A.
W86-05750

UNCERTAINTY IN RESERVOIR OPERATION,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
J. W. Delleur, and M. Karamouz.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 7-16, 3 fig, 1 tab, 19 ref. Grant No. CME 7916819.

Descriptors: *Water control, *Water allocation, *Reservoir operation, *Rivers, Gunpowder River, Maryland, Reservoir releases, Flow control, Model studies, Mathematical models, Loch Raven Reservoir, River flow, Water supply.

The annual and monthly reliabilities of a single reservoir with releases regulated to minimize losses were determined using data from the Gunpowder River and Loch Raven Reservoir, Maryland, from 1963-1977. The annual reliability depended more strongly on the draft ratio than on the storage coefficient. The reason for this was that the safe

range of the release of 0.4 MAF (0.8-1.2 MAF) corresponded to 1.22 standard deviations of the annual flows. A large percentage of the flows were within this range. A reliability of 50% was obtained with a draft ratio of unity. The reliability increased uniformly as the draft ratio decreased. As the reservoir capacity increased, there was more control and the probability of high drafts (floods) and low drafts (droughts) was reduced. The annual flows were disaggregated into monthly flows to evaluate the monthly reliability of the reservoir. (See also W86-05750) (Cassar-PTT)
W86-05751

PROBABILITY OF EXTREME LOW FLOWS OF VARIOUS DURATIONS,

Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
T. A. McMahon, and R. Strikanthan.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 31-35, 3 tab, 6 ref.

Descriptors: *Rivers, *Low flow, *Model studies, *Forecasting, Wilmot River, Murray River, Warragamba River, Australia, Streamflow forecasting, Simulation, Statistical analysis.

Low flow sums of various durations and probabilities were calculated by an analytical method and simulation. Data was obtained from three Australian rivers – Wilmot, Murray, and Warragamba – for periods of 45, 75, and 79 years, respectively. Analytical results compared well with simulation results for all three rivers, especially for duration events longer than one year. For highly variable streams, such as the Warragamba, the method of moments is suggested. (See also W86-05750) (Cassar-PTT)
W86-05753

POTENTIAL WATER YIELD IN SEMIARID REGIONS,

Ministry of Water Resources and Development, Harare (Zimbabwe).
For primary bibliographic entry see Field 2A.
W86-05754

RESERVOIR STORAGE YIELD ANALYSIS FOR ARID AND SEMIARID CLIMATES,

Institute of Hydrology, Wallingford (England).
Y. P. Parks, and A. Gustard.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 49-57, 6 fig, 1 tab, 10 ref.

Descriptors: *Reservoirs, *Water yield, *Water storage, *Evaporation, *Reservoir storage, Storage, Arid lands, Semiarid lands, Botswana, Gaborone Reservoir, Reservoir yield, Simulation, Model studies.

Storage yield analyses were required for four reservoir sites in Botswana. The semiarid climate provided particular constraints to the analysis as the average annual open water evaporation is more than three times the average annual rainfall. The choice of technique is briefly discussed with particular reference to the short river flow series available for investigation. A behavior analysis of flow data at Gaborone reservoir illustrates the technique in determining a storage requirement for a particular yield and probability of failure. A new technique for estimating the probability of failure from the distribution of non-failures is described incorporating monthly evaporation estimates over the changing surface area of the reservoir. The importance of accounting for evaporation in reservoir yield determination is demonstrated by comparing the storage yield relationships of three other sites. (See also W86-05740) (Author's abstract)
W86-05755

UNCERTAINTY IN RESERVOIR DESIGN - BENEFITS FROM USING SECONDARY DATA,

Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
D. Rosbjerg, and L. Gottlieb.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 59-67, 7 fig, 1 tab, 3 ref.

Descriptors: *Rainfall-runoff relationships, *Reservoirs, *Water storage, *Reservoir storage, Storage, Model studies, Johan Dahl Land, Greenland, Runoff forecasting, Design criteria, Forecasting, Data interpretation, Stochastic hydrology.

In the design of a reservoir storage two different types of uncertainty should be considered. The first type is due to the inherent stochastic nature of the runoff process, while the second type arises from the fact that the basis for the design is an historical series of limited length. The first type of uncertainty is evaluated by analyzing the distribution of the necessary storage volume, which is obtained by data generation. Then, when the sampling variance of the generation parameters is taken into account, the second type is evaluated in connection with a case study. Four years of measured daily runoff values from the Johan Dahl Land in Greenland are extended by 15 years of synthetic daily values obtained by a conceptional runoff model, leading to a significant decrease in the design storage volume. (See also W86-05750) (Author's abstract)
W86-05756

MULTISITE DATA GENERATION MODEL FOR DAILY DISCHARGES,

Bochum Univ. (Germany, F.R.).
K. Schneider, and G. A. Schultz.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 69-78, 7 fig, 1 tab, 10 ref.

Descriptors: *Reservoirs, *Rainfall-runoff relationships, *Discharge frequency, Forecasting, West Germany, River flow, Mathematical model, Model studies, Runoff, Multireservoir networks, Stochastic hydrology, Synthetic hydrology, Discharge hydrographs.

For the simulation of the performance of a complex reservoir system in the Federal Republic of Germany, a model is presented which generates sequences of daily inflows to several reservoirs within one river basin. The model preserves the important statistical and hydrological characteristics of the observed records. It is based on the stochastic generation of so-called pulses in consideration of the cross-correlation between the time series at the various sites. The model for the generation of these cross-correlated pulses consists mainly of two steps: the generation of the length of dry intervals (without pulse) and wet intervals (with pulses) and the generation of the pulse heights for each site and day (during wet periods) using an approximate multivariate autoregressive model. These pulses occurring on certain days at various sites are used as input into linear systems. The convolution with variable system functions (determined separately for each site) produces the output, namely daily river flow sequences for each site. (See also W86-05750) (Author's abstract)
W86-05757

FUZZY MODELLING FOR FORECASTING DISCHARGE AND WATER LEVEL OF LARGE RIVERS,

Technische Univ., Dresden (German D.R.). Bereich Hydrologie and Meteorologie.
N. Hansel, and B. Straube.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 2335-240, 7 fig, 5 tab, 3 ref.

Descriptors: *Rivers, *Water level, *Discharge measurements, *Flow, River flow, Forecasting, Model studies, Fuzzy models, Elbe River, Germany, Hydrographs.

The method of fuzzy sets is suitable for modelling the forecasting of discharge and water level in large rivers. This model consists of a structure, each of the partial structures being fuzzy relations. It is applied to the Elbe River in two versions for discharge and water level at different degrees of discretization (one day or 6 hours). The method of fuzzy sets allows description of large rivers as a whole, construction of a model on the basis of relatively few data, direct utilization of experience, and consideration of topical information on the state of the system. (See also W86-05750) (Cassar-PTT)
W86-05773

STOCHASTIC TIME SERIES ANALYSIS AND THE VILLAGE DAM MANAGEMENT PROBLEM IN SRI LANKA,

Australian National Univ., Canberra.
S. Mahendrarjah, P. Young, and A. Jakeman.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 251-264, 6 fig, 3 tabs, 19 refs.

Descriptors: *Reservoirs, *Dams, *Water management, *Sri Lanka, Arid lands, Systems analysis, Developing countries, Rice, Agriculture, Irrigation, Time series analysis, Stochastic hydrology.

A general method for analyzing the poorly defined natural-environment village exist today. The entrapped water is used for irrigation of rice crops and as a multipurpose community supply. The approach involves the combination of stochastic time series analysis and stochastic (Monte-Carlo) simulation. On the basis of limited time series data, a simple but nonlinear, stochastic, dynamic model for storage level in the dam is identified and estimated using a recursive method of time series analysis. This stochastic model is then used to define locally optimum management strategies and comparing these with existing practices. The study revealed a common-sense management plan: cultivation of two rice crops per year while avoiding the probability of emptying the dams. (See also W86-05750) (Cassar-PTT)
W86-05775

DERIVATION AND USE OF CONTROL CURVES FOR THE REGIONAL ALLOCATION OF WATER RESOURCES,

North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 6A.
W86-05777

APPLICATION OF STOCHASTIC DYNAMIC PROGRAMMING IN OPTIMIZING THE REGULATION OF HYDROPOWER RESERVOIRS,

Nanjing Hydrological Research Inst. (China).
T. Weiyan, L. Jianmin, H. Shouxin, and F. Shuxin.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 307-314, 1 tab, 7 ref.

Descriptors: *Hydraulic structures, *Reservoirs, *Optimization, Dynamic programming, Model studies, Hydroelectric plants, Powerplants, Runoff forecasting, Stochastic hydrology, Reservoir operation, Markov process, Water storage.

This paper discusses a problem in the theory of dynamic programming and Markovian decision processes, concerning a hydroelectric plant with a long term storage reservoir operating in a power system together with several run-of-river generating plants. The objective is to establish its regulating chart and various operating characteristics. In a working example, this chart will increase both the total guaranteed output in the dry season and the annual generation by 1-2% compared with a conventional one on the basis of a historic runoff record. (See also W86-05750) (Author's abstract)
W86-05780

STUDY OF A REAL TIME ADAPTIVE CLOSED-LOOP RESERVOIR CONTROL ALGORITHM,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. B. Buchanan, and R. L. Bras.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 317-326, 2 fig, 3 tab, 4 refs.

Descriptors: *Hydrologic models, *Reservoir operation, *River forecasting, *Water management, Model studies, High Aswan Dam, Egypt, Dynamic programming, Forecasting, Irrigation, Powerplants, Floods, Stochastic hydrology.

A comparison is made of a heuristic operating policy for the High Aswan Dam with that resulting from a steady state stochastic dynamic programming solution, from areal time adaptive control formulation that used multi-lead forecasts of river flows. The objective is to minimize losses due to irrigation deficits, power production deficits and damages due to flooding. It can be concluded that performance is better with the steady state solution, and it is best using the adaptive formulation. The use of forecasts and the adaptive formulation significantly reduces flood damages. (See also W86-05750) (Author's abstract)
W86-05781

PERFORMANCE OF A MAJOR RIVER REGULATION RESOURCE SYSTEM UNDER DESIGN CONDITIONS,

Severn-Trent Water Authority, Malvern (England).
R. C. Goodhew.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 337-355, 6 fig, 3 tab, 16 ref.

Descriptors: *Water management, *Rivers, *Drought, *Reservoir operation, Severn-Trent Water Authority, River flow, Water conservation, Conservation, Reservoir operation, Severn River, England, Wales, River forecasting, River systems, Weirs, Monitoring.

A river regulation system for the River Severn in Wales and England was tested by a severe drought in 1975-1976, less than a decade after its implementation. Measures to control waste are described. These were hampered by difficulties and uncertainties in forecasting river flow. The number of reservoir releases was minimized to reduce soaking into the bank. Pulse releases from one reservoir helped to reduce the drawdown at another reservoir; however, this produced unsteady conditions in the river. Bankside reservoirs were used as additional storage and permitted close control of flows. The river control system did not perform exactly as designed, based on the drought of 1949. The 1975-1976 drought was more severe and had lower groundwater levels at the beginning of the dry period. In addition, the river flow support demand far exceeded expectations. Several improvements were implemented: changed control rules, a new measuring weir and other monitoring devices, better forecasting of runoff, radar weather forecasting, optimized pump control, reduced transit losses, and extra storage schemes. (See also W86-05750) (Cassar-PTT)
W86-05783

ALLOCATION OF FRESH WATER RESOURCES OF A TIDAL ESTUARY,

Southern Water Authority, Worthing (England).
P. W. Herbertson, and W. J. Dovey.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 357-365, 2 fig, 1 tab, 5 ref.

Descriptors: *Estuaries, *Water management, *Reservoirs, *Water allocation, Environmental effects, Broad Oak Reservoir, England, Stour Estuary, Pumped storage, Competing use, Marshes.

A proposal to construct the Broad Oak pumped storage reservoir, England, was opposed, partly because some persons felt that the residual fresh water after abstraction would be inadequate. Some of the competing uses were marsh feeding, irrigation, cooling water, water quality protection, navigation, siltation scour, and recreation. The tidal and salinity regime of the estuary was analyzed to estimate the effects of the abstraction. It was concluded that long-term remedial measures were necessary to support a doubling of spray irrigation with water of the desired quality. Possible methods of achieving this goal were pumped marsh feeding, independent of the tide, or elimination of the Snowdown minewater discharge. Increased abstraction would also increase the amount of siltation. The proposed scheme was not approved, and alternate proposals are being considered. (See also W86-05750) (Cassar-PTT)
W86-05784

OPTIMIZATION MODELS FOR THE OPERATION OF MAJOR HYDROSYSTEMS,

California Univ., Davis. Dept. of Land, Air and Water Resources.
M. A. Marino, and B. Mohammadi.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 385-394, 4 fig, 4 tab, 5 ref.

Descriptors: *Water management, *Reservoir operation, Multipurpose reservoirs, Model studies, Linear programming, Dynamic programming, Optimization, Water storage, Powerplants, Flood control, Hydroelectric power, Folsom Reservoir, Shasta Reservoir, California, Algorithms, California Central Valley Project.

Presented are models and an efficient algorithm for the real time monthly operation of both a single and two multipurpose reservoirs. Each model is a combination of linear programming (used for month-by-month optimization) and dynamic programming (used for annual optimization). The use of parametric linear programming, minimum required beginning of month storage, and an iterative solution procedure lead to reduced requirements of both time and storage in the computer. Low storage requirements allow the models to be run on minicomputers. Water and power maximization for peak demand months and water and power maximization with flood control protection are considered. Hence, the models provide the reservoir operator with different choices for annual optimization. The models are illustrated with applications to a single and two multipurpose reservoirs of the California Central Valley Project. (See also W86-05750) (Author's abstract)
W86-05787

STATE OF THE ART REVIEW: THEORIES AND APPLICATIONS OF SYSTEMS ANALYSIS TECHNIQUES TO THE OPTIMAL MANAGEMENT AND OPERATION OF A RESERVOIR SYSTEM,

California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 6A.
W86-05790

USING THE DWOPER ROUTING MODEL TO SIMULATE RIVER FLOWS WITH ICE,

Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 8B.
W86-05795

SHORELINE REVEGETATION STUDIES AT LAKE TEXOMA ON THE RED RIVER, TEXAS-OKLAHOMA,

Southeastern Oklahoma State Univ., Durant. Dept. of Biological Sciences.
For primary bibliographic entry see Field 2I.
W86-05805

PHYSICAL MODELING OF RESERVOIR HYDRODYNAMICS,

Army Engineer Waterways Experiment Station, Vicksburg, MS. Hydraulics Lab.
For primary bibliographic entry see Field 2A.
W86-05806

PROBLEMS WITH MODELING REAL-TIME RESERVOIR OPERATIONS,

Lakehead Univ., Thunder Bay (Ontario). School of Engineering.
E. K. Can, and M. H. Houck.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 111, No. 4, p 367-381, October 1985. 9 fig, 3 tab, 7 ref, append.

Descriptors: *Reservoirs, *Reservoir design, *Model studies, Watershed models, Real-time operations.

The existence of several problems associated with the optimization of real-time operations of reservoir systems is demonstrated. One problem is due to the use of imperfect streamflow (inflow to the reservoir) forecasts. There is a significant relationship between the reliability of the forecast information and the operating or forecast horizon to be used in the model. The implications of this relationship are illustrated using an example in which extending the forecast horizon beyond three days does not improve the performance of the model for real-time operations. Real-time operations models often require routing models that relate reservoir releases to the flows at downstream points. Use of approximate reach routing models may cause unexpected problems and may mislead the decision makers. The following procedure may help to alleviate some of these problems: 1) find a clearly underestimated routing model; use the historic inflows and run the optimization - simulation program; obtain a trade-off curve; and use this as a lower bound; 2) repeat step 1 with a clearly overestimated model to obtain an upper bound; and 3) discard any model yielding a tradeoff curve out of these bounds. If the bounds are sufficiently close to each other, the best routing model is easier to find. (Master-PTT)
W86-05809

PLANNING DETENTION STORAGE FOR STORMWATER MANAGEMENT,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
V. G. Loganathan, J. W. Delleur, and R. I. Segarra.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 111, No. 4,p 382-398, October 1985. 5 fig, 5 tab, 12 ref, append.

Descriptors: *Water management, *Storm water, Storm wastewater, Storage reservoirs, Storm runoff, Model studies, Storage requirements, Runoff volume, Urban runoff, Design criteria.

In a method for estimating detention storage capacity in stormwater management generalized storage-overflow relationship is derived. This relationship defines real average storage (empty space in detention basin) on the positive range and overflow volumes on the negative range. By using exponential probability density functions for the independent hydrologic variables runoff volumes, runoff durations, and interevent times, and the generalized storage relationship, a new probability distribution is derived for the treatment plant overflow volumes. The new distribution provides an easy method for estimating the detention storage and treatment capacity for a design risk level. The methodology has the advantage that it provides easy to use preliminary planning information for stormwater management without the need for extensive simulation. This application of the storage estimation equations is illustrated using data for Atlanta, Georgia. (Master-PTT)
W86-05810

DEVELOPMENT OF A FLOOD MANAGEMENT PLAN,

Goldberg-Zoino and Associates, Inc., Newton Upper Falls, MA.
D. W. Wood, T. C. Gooch, P. M. Pronovost, and

D. C. Noonan.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 111, No. 4, p 417-433, October 1985, 5 fig, 5 tab, 22 ref.

Descriptors: *Floods, *Water management, *Management planning, Planning, New Hampshire, Keene, Legislation.

A comprehensive flood plain management plan was developed for the city of Keene, New Hampshire, reflecting the policies of Section 73 of Public Law 93-251. Community attitudes were investigated through questionnaires, interviews with community leaders, and interaction with a community advisory committee. A full range of available nonstructural and structural flood damage reduction measures were surveyed. An initial set of measures was selected based on physical, economic, and political feasibility in Keene given the existing stream conditions, available stage-damage estimates and community attitudes. These initial measures were evaluated in detail, and three alternative flood plain management plans were developed and analyzed using benefit-cost and environmental assessment procedures. The recommended plan included: a technical assistance program to aid home-owners with flood-proofing; small dikes to protect selected structures from flooding; channel improvements at constrictions; enhancement of existing storage by restoration of a damaged dam; and development of a flood warning emergency preparedness system. The experience of Keene represents a prototype study and a model for future studies. (Master-PTT)
W86-05812

SKILL TESTS AND PARAMETRIC STATISTICS FOR MODEL EVALUATION,

Ohio State Univ., Columbus. Dept. of Civil Engineering.
J. S. Dingman, and K. W. Bedford.
Journal of Hydraulic Engineering (ASCE)JAEND8, Vol. 112, No. 2, p 124-141, February 1986. 5 fig, 6 tab, 23 ref, append. NOAA contracts NA79AA-D-00120 and NA80AA-D-0010.

Descriptors: *Model studies, *Statistical analysis, *Storm surges, *Statistical models, Surface water, Water resources, Lake Erie, Surges, Time series analysis, Decision making.

A series of traditional statistical methods and nonparametric skill tests are assembled into a model statistical analysis program (MSAP) with the intent of evaluating their ability to verify surface water models. Using two different hydrodynamic models, simulations of two Lake Erie storm surges were performed, with actual water levels for each storm surge obtained from monitoring stations around the lake. The actual and computed water levels were analyzed by MSAP. Of the three major categories of statistical tests contained in MSAP, the skill tests were superior in demonstrating a model's ability or inability to predict the most important aspect of a storm-surge simulation: its creation and die-off. Time-series statistical calculations such as correlation coefficients and root-mean-square deviation values were helpful only in assessing gross overall model performance. Statistical decision-making tests, based on the acceptance or rejection of certain hypotheses within a specified level of significance, yield overly optimistic or incorrect results due to the violation of several assumptions necessary for proper use of the tests. (Master-PTT)
W86-05817

OPTIMAL CONTROL OF SEA LEVEL IN A TIDAL BASIN BY MEANS OF THE PONTRYAGIN MAXIMUM PRINCIPLE,

Osservatorio Geofisico Sperimentale, Trieste (Italy).
For primary bibliographic entry see Field 8B.
W86-05829

CYANATRYN: DEGRADATION AND EFFECTIVENESS IN CONTROLLING AQUATIC PLANTS,

BASF Canada, Inc., Toronto (Ontario).
For primary bibliographic entry see Field 5B.
W86-05850

MEETING STREAMFLOW REQUIREMENTS,

Wyoming State Engineers Office, Cheyenne.
For primary bibliographic entry see Field 4A.
W86-05867

MEETING STREAMFLOW REQUIREMENTS,

Wyoming State Engineers Office, Cheyenne.
F. J. Trelease.
American Water Works Association Journal JAWWA5, Vol. 77, No. 9, p 48-52, September 1985. 2 fig, 1 tab, 16 ref.

Descriptors: *Instream Flow, Surface Water Availability, Water Use, Water Permits, Protection, Decision Making, Administrative Decisions, Project Planning.

As a result of the growing trend within the United States to protect and provide in-stream flows, the states are adopting a variety of means to meet streamflow requirements. The most common methods are reservation of minimum streamflows, placing conditions on water use permits, and stream protection systems. In-stream flows may also be required as conditions of project authorizations, licenses, and administrative decisions. (Author's Abstract)
W86-05867

AQUATIC WEED CONTROL IN A RECREATIONAL LAKE,

R. B. Purdue.
Public Works, Vol. 116, No. 9, p 117, 170, September 1985.

Descriptors: *Aquatic weed control, *Lakes, *Recreation, Lake Adirondack, New York, Weed control, Aquashade, Plant growth.

Lake Adirondack in the town of Indian Lake, New York, was plagued by a long-stemmed, broad-leafed weed known by a number of names as bass weed, broad-leafed pond weed etc. It propagates by seeding, by producing new stems from expanding root systems, and by re-rooting cut and fragmented stems. The town finally decided in 1982 that money would be required to defeat the bass-weed. A program was chosen, using Aquashade, which produced remarkable results. Aquashade is a blue, non-toxic, vegetable coloring agent that filters out the growth-supporting portion of the sun's light. The bass weed sprouts did grow, reflecting periods of low dye concentration, the weed stayed out of sight. This made the lake more accessible for recreational use. (Khumbatta - PTT)
W86-05877

BRECON FLOOD ALLEVIATION SCHEME,

MacDonald (M.) and Partners, London (England).
D. G. Hutchinson, and R. A. Smith.
Institution of Civil Engineers PCIEAT, Vol. 80, Part 1, p 121-143, February 1986. 13 fig, 7 ref.

Descriptors: *Flood control, *Wales, Brecon, Flooding, Engineering, Construction, Wales, Usk River, Channel improvement.

Major floods have occurred periodically in Brecon, a rural town within the Brecon Beacons National Park in Powys, South Wales. A feasibility study following a 1979 flood concluded that the solution to the flooding problem would include a combination of channel improvement (including lowering the invert of the Llanfaes Bridge) and defence raising. Construction began in 1981 and lasted 80 weeks. The key to the scheme, and its most difficult aspect, was lowering the bed of the River Usk under the bridge, a designated ancient monument. The scheme proved successful in the year following its completion, and a flood in 1983 was contained at levels which correlated well with those predicted. The lowered bridge inverts proved to be self cleansing. (Doria-PTT)
W86-05904

STRUCTURE OF TURBULENCE IN COMPOUND CHANNEL FLOWS,

Ottawa Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-05965

OVERBANK FLOW WITH VEGETATIVELY ROUGHENED FLOOD PLAINS,

California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-05966

RIVER FLOOD ROUTING BY NONLINEAR MUSKINGUM METHOD,

Wyoming Water Research Center, Laramie.
For primary bibliographic entry see Field 2E.
W86-05980

ANALYSIS OF HYDRILLA-INHIBITING FRACTIONS IN NATURAL WATERS: THE CONCEPT OF 'FINGERPRINTING' THROUGH LIQUID CHROMATOGRAPHY,

University of South Florida, Tampa. Dept. of Chemistry.
D. F. Martin, P. M. Dooris, G. M. Dooris, and R. J. Bova, Jr.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 283-287, April 1986. 2 fig, 2 tab, 20 ref.

Descriptors: *Hydrilla, *Aquatic weeds, *Plant growth substances, *Liquid chromatography, Florida, Lake Starvation, White Trout Lake, Lake sediments, River water, Chemical analysis, Chromatography.

High performance liquid chromatography was used to identify a fraction of aqueous sediment extract from Lake Starvation, Hillsborough County, Florida, that is responsible for inhibition of hydrilla growth. The fraction was separated on a Zorbax(TM) C sub 18 preparative-scale column. The present study examined various lake sediment extracts and river water samples for the presence or absence of the inhibitor peak. The biologically active component was absent in certain rivers where hydrilla is prominent, but it was present in extracts of Lake Starvation and White Trout Lake sediments that are known to have hydrilla growth inhibiting properties. 'Fingerprinting' of natural waters for hydrilla inhibitor through liquid chromatography would be a useful management tool and information on the relative concentration of inhibitor would indicate potential for hydrilla growth, maintenance or inhibition. (Rochester-PTT)
W86-06023

CHANGES OF IN-CHANNEL VEGETATION FOLLOWING TWO-STAGE CHANNEL CONSTRUCTION ON A SMALL RURAL CLAY RIVER,

University Coll., London (England). Dept. of Geography.
P. J. Raven.
Journal of Applied Ecology, Vol. 23, No. 1, p 333-345, 1986. 3 fig, 6 tab, 23 ref, append.

Descriptors: *Aquatic plants, *Channeling, *Two-stage channel construction, *Species diversity, River Roding, England, Flood berms, Excavation, Scour, Succession.

Aquatic vegetation growth under, or emerging from, dry-weather water level along 5 km of the River Roding, near Abridge, Essex, England, was monitored during 1979-82 to assess floristic changes following two-stage channel construction. Aquatic plant communities remained stable in the absence of river engineering. In channel vegetation cover, species richness, and diversity were maintained when the undisturbed lowermost portion of river was incorporated into a two-stage channel. Vegetation cover increased for at least 2 yr after flood berm excavation. Species richness increased in the short term, but subsequently declined as invasive species, notably Sparganium erectum L.,

proliferated. Sagittaria sagittifolia L. and Sparganium emersum Rehmann rapidly became more abundant in the short-term but Nuphar lutea (L.) Sm. and Schoenoplectus lacustris (L.) Palla responded slowly and declined in relative abundance. Increased light and reduced scour along the channel edge created ideal conditions for the growth of tall emergent vegetation, and S erectum, Phragmites australis (Cav.) Trin ex Steudel and Typha latifolia L. proliferated along reaches bordered by low-level flood berms, in particular. Two-stage channel construction is ecologically preferable to channelization, but appropriate measures to counter excessive vegetation growth must be incorporated if the short-term benefits are to be maintained in the longer term. (Author's abstract)
W86-06037

TIME DEPENDENT THREE DIMENSIONAL SIMULATION OF FLOWS IN SHALLOW DOMAINS WITH VEGETATIVE OBSTRUCTION,
Miami Univ., Coral Gables, FL. Dept. of Mechanical Engineering.
S. Sengupta, S. S. Lee, and L. Q. Fu.
Applied Mathematical Modelling AMMODL, Vol. 10, No. 1, p 2-10, February 1986. 12 fig, 10 ref.

Descriptors: *Shallow water, *Vegetation effects, *Mathematical models, *Three dimensional simulation, Water management, Florida everglades, Water deliveries, Eddies, Evapotranspiration, Hydrologic budget.

A predictive, verified mathematical model can be used to evalute water management options prior to implementation. A three-dimensional time dependent model has been used to analyze and predict the effects of water management practices in Shark Slough in the Everglades, Florida. Calibrated vertical eddy viscosity was found effective in reproducting effects of vegetative obstruction. A modified Penman formula for evapotraspiration has been developed and the results verified with field data. The model can be used for practical evaluation of water budgets, local water depths, and inundation areas. (Main-PTT)
W86-06065

FATE OF 2,4-D ENTERING A FRESHWATER AQUATIC ENVIRONMENT,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
For primary bibliographic entry see Field 5B.
W86-06074

APPLICATION OF EXTREME VALUE THEORY TO FLOOD DAMAGE,
Montreal Univ. (Quebec). Dept. of Economics.
For primary bibliographic entry see Field 6C.
W86-06117

4B. Groundwater Management

OPTIMAL MANAGEMENT OF LARGE-SCALE AQUIFERS: METHODOLOGY AND APPLICATIONS,
Texas Univ. at Austin. Center for Research in Water Resources.
N. Wanakule, and L. W. Mays.
Water Resources Research WRERAO, Vol. 22, No. 4, p 447-465, April, 1986. 13 fig, 3 tab, 32 ref.

Descriptors: *Groundwater management, *Aquifer management, *Groundwater recharge, Recharge, Artesian aquifers, Model studies, GWMAN model, Edwards aquifer, Texas, Dewatering, Water table fluctuations, Management, Water allocation, Water policy, Mine drainage, Excavation, Pumping.

A methodology is developed for determining optimal pumping and recharge of large scale artesian and/or nonartesian aquifers. This methodology couples optimization techniques with existing groundwater simulation models. It can be applied to both groundwater policy evaluation (allocation) such as large-scale aquifers and to hydraulic management problems such as the dewatering of mining or excavation sites. The state variables which represent the heads and the control variables which represent the pumpage are implicitly related through the groundwater simulator. The simulator equations are used to express the states in terms of the controls, yielding a much smaller reduced problem. Techniques for computing gradients of reduced problem functions are described. The reduced problem is solved by combining augmented Lagrangian and reduced gradient procedures. The optimization-groundwater simulation system is referred to as GWMAN. Two small examples are solved in addition to both steady state and transient type dewatering problems. An application to the Edwards Aquifer in Texas is presented. (Author's Abstract)
W86-05425

SUSTAINED-YIELD GROUND-WATER PLANNING BY GOAL PROGRAMMING,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2F.
W86-05441

ALGORITHM FOR SURFACE/GROUNDWATER ALLOCATION UNDER APPROPRIATION DOCTRINE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6E.
W86-05445

ROLE OF VOLCANIC TUFFS IN GROUNDWATER REGIME OF VALLE CENTRAL, COSTA RICA,
British Geological Survey, Wallingford (England).
For primary bibliographic entry see Field 2F.
W86-05531

IMPROVEMENT OF METHODS OF LONG TERM PREDICTION OF VARIATIONS IN GROUNDWATER RESOURCES AND REGIMES DUE TO HUMAN ACTIVITY.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2F.
W86-05645

METHODOLOGY OF REGIONAL HYDROGEOLOGICAL FORECASTS FOR INTERBASIN WATER TRANSFER OPERATION,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
B. E. Antypko, I. S. Zektser, and N. A. Lebedeva.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 3-8.

Descriptors: *Water transfer, *Interbasin transfer, *Regional analysis, *Groundwater basins, *Groundwater management, Water resources development, Planning, Water quality, Water supply development, Groundwater movement, Regional development, Groundwater availability, Geohydrology, Groundwater recharge, Networks.

In the USSR, the inter-regional water transfer problem concerns the diversion of the water of northern rivers to southern regions of the country. Regional hydrogeological forecasts on the scale involved are unprecedented in the world's practice. The methodology of hydrogeological forecasts requiring an analysis of regions with areas of tens or hundreds of thousands of square kilometers should be based on quantitative and analytical calculations, checked against the data from existing analogous projects. Such an approach is possible if data are available on the hydrodynamic structure of the region under natural conditions and on the probable changes arising from the engineering factors. These primarily concern variations in groundwater flow, heads, seepage rates, levels, and chemical composition. Forecasts of changes in groundwater amount and quality are derivatives from the evolution of the hydrodynamic structure, landscape, climatic and morphometric particularities of regions. In areas with large seepage losses of surface water, the forecast of groundwater quality mainly depends on the chemical composition of surface water. (See also W86-05645) (Author's abstract)
W86-05646

METHODS USED IN THE PREDICTION AND CONTROL OF THE GROUNDWATER REGIME IN BASINS ADJACENT TO LARGE RIVERS,
For primary bibliographic entry see Field 2F.
W86-05647

ARTIFICIAL GROUNDWATER RECHARGE IN QUATERNARY GRAVEL AQUIFERS IN THE FORELAND OF THE ALPS,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
B. Herrling.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 33-41, 6 fig, 4 ref.

Descriptors: *Groundwater recharge, *Gravel aquifers, *Artificial recharge, *Numerical analysis, *Mathematical models, Aquifers, Model studies, Models, Mathematical studies, Groundwater movement, Groundwater storage, Sand aquifers, Alps.

The possibility of recharging groundwater with the high-water of streams in valleys of the glacial period which are filled with permeable sediments is numerically investigated. Due to the great distance between the water table and the surface in some of these regions, the use of gravel-pits as storage and seepage basins has been proposed and the consequences downstream in the valley are explored. A time dependent, two-dimensional horizontal finite element model has been employed. In addition. moving boundaries as a result of the sloping lateral edges of the aquifers have been considered within the model. Preliminary results are presented for a case study. (See also W86-05645) (Author's abstract)
W86-05649

LONG-RANGE PREDICTION OF GROUNDWATER LEVELS IN A VOLCANIC UPLAND USING AN AQUIFER MODEL WITH SOIL WATER SUBSYSTEM,
Tsukuba Univ. (Japan). Inst. of Geoscience.
For primary bibliographic entry see Field 2F.
W86-05650

PROBLEMS OF LONG-TERM GROUNDWATER REGIME AND RESOURCES FORECASTING,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2F.
W86-05651

METHOD OF DEFINING THE EXPLOITABLE RESOURCE OF A LARGE DEEP CONFINED AQUIFER UNDER THE CONDITION OF ANNUAL EQUILIBRIUM,
Hebei Province Geology Bureau, Shijiazhuang (China). Hydrogeological Station.
For primary bibliographic entry see Field 2F.
W86-05652

SOME HYDROGEOLOGICAL PROBLEMS RELATED TO URBAN WATER SUPPLY DEVELOPMENT IN CHINA,
Ministry of Geology and Minerals, Beijing (China). Bureau of Hydrogeology and Engineering Geology.
C. Mengxiong.

IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 81-86.

Descriptors: *Water supply, *Urban areas, *Geohydrology, *Groundwater mining, *Groundwater management, Water use, Thermal water, Geothermal resources, Artificial recharge, Groundwater recharge, Groundwater movement, Groundwater pollution, Water resources development, China, Competing use.

Many of the important cities in China are largely dependent upon groundwater for water supply. In the utilization and exploitation of groundwater in urban areas, some hydrogeological problems frequently arise: chiefly the competition between industrial and agricultural demands, land subsidence in urban areas on coastal plains, and groundwater pollution, most of which are caused by the arbitrary and excessive exploitation of groundwater. The chief measure to prevent to overextraction and the deterioration of the water quality is to establish a strict groundwater management system on a scientific basis. The development and utilization of geothermal water can provide not only an important supplementary source in urban areas, but also fairly favorable conditions for environmental protection. (See also W86-05645) (Author's abstract)
W86-05653

PROBLEMS OF GROUNDWATER RESOURCE MANAGEMENT IN A DEVELOPED BASIN,

Severn-Trent Water Authority (England).
M. A. Sayers, and A. C. Skinner.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 127-134, 1 tab, 8 ref.

Descriptors: *Groundwater management, *Groundwater recharge, *Groundwater mining, *Groundwater depletion, *Urban areas, Artificial recharge, Water resources development, Surface runoff, Water quality, Aquifers, England.

The valley of the Stour in the West Midlands of England is an example of a basin where extensive groundwater use close to an urban center poses special problems of water resource management. The relationship between the rate of replenishment of aquifer storage from rainfall and acceptable rates of abstraction varies with individual circumstances. Sufficient field data is seldom available to enable the options to be properly evaluated. The likely future of development for public water supplies depends upon the importation of surface water either for conjunctive use with groundwater or for artificial aquifer recharge. Another option, which is more attractive in that it can be more easily integrated with the exiting water supply system is one of using the available river water for intermittent artificial recharge. Such a scheme may help enhance groundwater quality. (See also W86-05645) (Geiger - PTT)
W86-05659

DYNAMIC FEATURES OF CONES OF INFLUENCE OF DEEP GROUNDWATER IN THE HEILONGGANG DISTRICT OF HEBEI PLAIN,

Hebei Province Geology Bureau, Shijiazhuang (China). Hydrogeological Station.
Z. Shaoduo, and L. Shaoran.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 149-158, 4 fig, 2 tab.

Descriptors: *Groundwater mining, *Groundwater depletion, *Groundwater level, *Aquifers, *Deep wells, *Hebei Plain, Groundwater management, Pump wells, Water supply development, China, Confined aquifers.

Groundwater, under natural conditions, may show long and short periodic variations. The normal variations may be damaged under the influence of artificial activities which may cause dynamic variations. The nature of these variations need to be examined so as to introduce control for abnormal variations and use the groundwater to benefit mankind. Two cones of influence that were formed by the development of too large an amount of deep confined groundwater in Hebei Province are described. The Cangzhou Cone encompasses a group of cones mainly extracting water from Zone III, and the Jixian-Zaogiang-Hengshui Cone uses water from Zone II and III. Causes of the cone formation have been linked to depletion of surface water supplies and overuse of groundwater, poor hydrogeological condition, lack of shallow fresh water, and an unreasonable distribution of extraction wells. A study of the groundwater features based on long-term observations is presented which suggests ways to mitigate the formation of the cones, thereby letting the groundwater serve the economic construction more effectively. (See also W86-05645) (Geiger - PTT)
W86-05661

RAINFALL-RECHARGE CORRELATION; A METHOD FOR EVALUATING POTENTIAL GROUNDWATER,

State Water Investigation Directorate, Calcutta (India).
For primary bibliographic entry see Field 2F.
W86-05662

LONG-RANGE GROUNDWATER LEVEL PREDICTION BASED ON TIME SERIES ANALYSIS,

Budapesti Mueszaki Egyetem (Hungary). Inst. of Water Management.
For primary bibliographic entry see Field 2F.
W86-05665

EVALUATION OF PUMPING TESTS; IDENTIFICATION OF PARAMETER VALUES AND THEIR RELIABILITY,

Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
A. Leijnse.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 195-203, 6 fig, 1 tab, 3 ref.

Descriptors: *Mathematical studies, *Groundwater movement, *Pumping tests, *Drawdown, Prediction, Analysis of variance, Mathematical equations, Geohydrology, Hydrologic parameters, Statistical analysis.

In many cases it is common practice to carry out a pumping test in order to identify the values of the hydrological parameters that play a role in groundwater flow problems. Analysis of the data collected during a pumping test should result in the 'best fit' values of these parameters. Instead of straightforward curve fitting, more sophisticated statistical methods can be employed for the analysis of pumping test data. In doing so, information can be obtained on both the 'best fit' values of the hydrological parameters and the reliability of these values. This reliability can be quantified in either a simple approximate way or in a more complex way. In both cases, the reliability of predictions made with the aid of the hydrological parameters can be calculated. As a practical example, the application of the method to a steady state pumping test in a semi-confined aquifer will be considered. 'Best fit' parameter values and their reliability have been calculated. The reliability of the prediction calculated with the aid of these parameter values are given for both the simple and the more complex approach. (See also W86-05645) (Author's abstract)
W86-05666

ANALYSIS OF PERENNIAL FLUCTUATIONS OF THE GROUNDWATER TABLE IN PART OF THE ALLUVIO-PROLUVIAL FAN OF YONGDING RIVER, CHINA,

Beijing Municipal Hydrogeological and Engineering Geological Corp. (China).
For primary bibliographic entry see Field 2F.
W86-05667

AQUIFER DEMANDS MET FROM STORAGE OR RECHARGE,

Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-05668

GROUNDWATER SIMULATION MODEL FOR A SHALLOW WATER TABLE AQUIFER,

Haryana Agricultural Univ., Hissar (India). Centre of Soil and Water Management.
J. Singh, and R. Kumar.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 233-240, 3 fig, 2 tab, 3 ref.

Descriptors: *Groundwater recharge, *Simulation analysis, *Water table, *Groundwater level, *Groundwater mining, Irrigation, Canals, Model studies, Mathematical models, Models, Aquifers, Pump wells, Ganges River, Indus River, India, Mathematical studies, Confined aquifers.

A groundwater simulation model is developed to predict the dynamic behavior of a water table in response to groundwater pumpage and net recharge over a canal distribution area of the alluvial plain of the Ganges and Indus rivers and their tributaries. The model is based on the partial differential equation governing the non steady-state two-dimensional flow of groundwater in a confined, nonhomogeneous, isotropic aquifer. The groundwater balance equation contained such estimated components as available water, rainfall, subsurface inflow and outflow, actual evapotranspiration, and capillary rise. The pumped water will be used in conjunction with canal water for irrigation, keeping the electrical conductance of resultant water less than 2000 microhos/cm. (See also W86-05645) (Geiger - PTT)
W86-05670

MATHEMATICAL MODEL OF COMPLEX, LEAKY, MULTI-AQUIFER SYSTEMS AND ITS SOLUTION,

Zhengding Inst. of Hydrogeology and Engineering Geology (China).
For primary bibliographic entry see Field 2F.
W86-05672

PROBLEMS OF GROUNDWATER DEVELOPMENT IN THE SANA'A BASIN, YEMEN ARAB REPUBLIC,

Humphreys (Howard) and Partners, Leatherhead (England).
A. N. Charalambous.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 265-274, 3 fig, 5 ref.

Descriptors: *Groundwater mining, *Groundwater potential, *Aquifers, *Groundwater depletion, *Water demand, *Yemen, Geohydrology, Groundwater level, Groundwater recharge, Wells, Boreholes, Water resources development, Sana'a Basin, Competing use, Sandstone.

Until recently the hydrogeology of the Sana'a was little known. Studies in 1972 to identify a source of water supply for Sana'a indicated that the Tawilah sandstone could meet the city's requirements to the year 2000 and beyond. Thus, all further work was directed in developing this aquifer. At the same time, local farmers who until recently relied on abstraction from shallow well, embarked on a program of intensive exploitation by boreholes, which has remained largely uncontrolled. This has led to declining water levels which have placed the now completed wellfields at serious risk. Examination of the aquifer in the light of the present situation indicates that previous assessments of recharge by the throughflow method have significantly overestimated the resource. Lack of data rather than hydrogeological techniques are considered to have been the major factor. (See also W86-05645) (Author's abstract)
W86-05673

GROUNDWATER RESOURCES DEVELOPMENT IN INDIA,

Minor Irrigation Dept., Lucknow (India).
A. C. Chaturvedi.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 275-283, 9 ref.

Descriptors: *Groundwater mining, *India, *Groundwater recharge, *Water demand, *Water resources development, Artificial recharge, Reservoirs, Water supply development, Water use, Groundwater depletion, Water law, Groundwater management, Competing use.

Groundwater has to be developed as a very high priority in India to meet the competing demands of irrigation and at the same time to meet the requirements of municipalities for drinking and sanitation control. Water requirements for the various states of the Indian Union have been determined using simulation studies and a series of reservoirs has been planned in the upper reaches of streams to make regulated supplies available all the year round. Underground reservoirs are now being considered in various states and will have the advantages of no evaporation losses and no loss of land due to flooding. Artificial recharge via lagoons and wells is under way and it is estimated that the quantity that can be recharged annually amounts to nearly 10% of the country's exploitable water resources. (See also W86-05645) (Author's abstract)
W86-05674

DEVELOPMENT OF GROUNDWATER RESOURCES IN THE NETHERLANDS,

Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands).
W. Cramer.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 285-296, 6 fig, 2 tab, 12 ref.

Descriptors: *Water resources development, *Groundwater mining, *Groundwater management, *Decision making, Models, Water quality, Environmental Impact Statement, Geohydrology, Groundwater potential, Groundwater recharge, Netherlands.

In the Netherlands, groundwater is a very important source for water supply and is available in considerable quantities, due to favorable hydrological conditions. However, the possibilities for exploitation are limited because of the influence of withdrawal on agriculture and the natural environment. On the other hand, several human activities cause deterioration of the groundwater quality and consequently restrict the possibilities for explotation. Water resources management now requires detailed information on available groundwater resources. Until the present time the assessment of groundwater resources in the Netherlands has been based on extensive regional and local hydrological investigations and a rough estimation of the consequences on the interests involved. In addition, consideration of the balance of interests is very limited and not objective. The approach followed does not meet current requirements. Optimization and multi-criteria decision models are now being developed and tested for their application under Dutch conditions. However, the complex hydrological system and the difficulties in formulating the constraining criteria have delayed a practical and satisfactory outcome. (See also W86-05645) (Author's abstract)
W86-05675

IMPACT OF A FUTURE QATTARA SALT-WATER LAKE ON THE NUBIAN SANDSTONE AQUIFER SYSTEM IN THE WESTERN DESERT, EGYPT,

Organization for Land Reclamation and Agriculture Development Projects, Cairo (Egypt).
M. A. Ezzat.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 297-314, 11 fig, 15 ref.

Descriptors: *Environmental Impact Statement, *Groundwater level, *Aquifers, *Egypt, *Electric powerplants, *Saline lakes, Model studies, Geohydrology, Environmental effects, Arid-zone hydrology, Saline water intrusion, Water resources development, Qattara, Sandstone.

The impact of a future Qattara salt-water lake on the present hydrodynamic equilibrium of the Nubian Sandstone aquifer system was examined with the aid of a digital groundwater model. The effects of the Qattara Depression hydrosolar power plant in particular were examined. The filling of the depression to 60 m below mean sea level (b.m.s.l.) will prevent the loss of the Nubian groundwater beneath the area which will be covered by a future lake. Filling the depression to a level of 60 m b.m.s.l. will cause the positive effect of a 70 m head of salt water on the Nubian Sandstone system, which will in turn increase heads in the nearby oases. In order to study this effect, a two-layer, three-dimensional model is needed to simulate the hydrogeologic conditions underlying the greater Qattara Area, to include Siwa, Baharein, Sitra, and Bahariya Oases. Salt water intrusion into the groundwater bodies underlying or adjacent to the depression is not possible because all hydraulic heads are considerably higher than the filling level of 60 m b.m.s.l. (See also W86-05645) (Geiger - PTT)
W86-05676

GROUNDWATER REGIME FORECASTING WITH INADEQUATE DATA IN ARGENTINA,

La Plata Univ. (Argentina).
J. M. Sala, M. A. Hernandez, and E. E. Kruse.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 315-324, 8 fig, 5 ref.

Descriptors: *Groundwater, *Forecasting, *Saline water intrusion, *Prediction, *Geohydrology, *Aquifers, *Argentina, Groundwater movement, Permeability, Regional analysis, Hydrologic data collections, Data interpretation, Leaky aquifers, Water Resources Development, Theoretical analysis, Buenos Aires.

Buenos Aires Province is an extensive plain with an area of 310,000 sq km; its demographic density is the highest in the country but has an uneven distribution. The development of the country has taken place over the last century, especially in the past 50 years. The lack of adequate data, such as subsurface and historical information about the groundwater regime, together with an increase in water demand, requires consideration in any solution to the problems. It is necessary, therefore, in the short term to undertake special studies to provide a reliable basis for forecasts. Such conditions led to the adoption of methods of interpolation, extrapolation and estimation of the required parameters. In order to reduce the uncertainty in the results, basic lines of investigation were employed convergently, i.e., water balance, geology, groundwater hydrology and hydrochemistry. Different degrees of importance have been given according to the cases analyzed. (See also W86-05645) (Author's abstract)
W86-05677

SIMULATION MODEL FOR THE MANAGEMENT OF GROUNDWATER IN THE YUN-LIN BASIN,

National Taiwan Univ., Taipei. Dept. of Agricultural Engineering.
Y. -S. Tsao.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 333-343, 5 fig, 6 ref.

Descriptors: *Model studies, *Groundwater management, *Groundwater mining, *Mathematical models, *Groundwater depletion, Water quality, Saline water intrusion, Pumping, Pump wells, Simulation analysis, Finite element method, Mathematical studies, Groundwater basins, Water supply development, Yun-Lin Basin, Taiwan.

Due to over-reliance and over-pumping of groundwater in the Yun-Lin Basin, ill-effects such as seawater intrusion, land subsidence, lowering of groundwater level, and deterioration of groundwater quality are found to be in existence and becoming more serious every year. A finite-element model, using Galerkin's weighting residual method, was set up to simulate the problem. It is found that all ill-effects can be controlled by modifying the pumping pattern alone without materially reducing the volume of extraction. (See also W86-05645) (Author's abstract)
W86-05678

GROUND WATER IN WATER RESOURCES PLANNING.

United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
Available from the International Association of Hydrological Sciences, 2000 Florida Ave., NW, Washington, DC. 20009, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. 659 p.

Descriptors: *Water resources planning, *Water demand, *Groundwater, Groundwater depletion, Groundwater recharge, Groundwater pollution, Groundwater protection.

Groundwater resources are often subject to overdevelopment and to impairments in quality. This symposium presents papers written by specialists in the fields of science, engineering, operations and management, covering topics such as: the multiple demands and conflicts on groundwater; the planning and management of groundwater; and the hazards to, and protection of, groundwater. (See also W86-05680 thru W86-05733) (Lantz-PTT)
W86-05679

POSSIBILITIES AND LIMITS OF HYDROGEOLOGICAL PRESERVATION OF THE RECORD IN THE PRELIMINARY STAGE OF LARGER GROUNDWATER WITHDRAWALS AS EXEMPLIFIED BY THE NORDHEIDE WATERWORKS (NORTHERN LOWER SAXONY),

Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
For primary bibliographic entry see Field 7B.

W86-05680

CONCEPTUAL PLAN FOR WATER MANAGEMENT SCHEMES IN THE NORTHERN PART OF THE RHENISH LIGNITE MINING DISTRICT,

Rheinische Braunkohlenwerke A.G., Cologne (Germany, F.R.).
For primary bibliographic entry see Field 3E.
W86-05681

EFFECTS OF INSUFFICIENT RECHARGE FOR AQUIFER LAYERS IN AIN BENI MATHAR (OUJDA PROVINCE, EAST MOROCO) (ALIMENTATION INSUFFISANTE DES COUCHES AQUIFERES ET SES CONSEQUENCES DANS LA REGION D'AIN BENI MATHAR (PROVINCE D'OUJDA, MAROC ORIENTAL)),

Erlangen-Nuernberg Univ. (Germany, F.R.). Inst. fuer Geographie.
E. Jungfer.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 581-591, 3 fig, 4 ref.

Descriptors: *Groundwater recharge, *Infiltration rate, *Aquifers, *Ain Beni Mathar, *Morocco, *Deep percolation, Ephemeral streams, Groundwater depletion, Radioactive dating, Water use, Industrial water, Irrigation water, Artesian Springs.

In the uplands of East Morocco large areas of the Jurassic aquifer are covered by impermeable sediments belonging to the late Tertiary. For that reason the aquifer is recharged only by deep percolation in the ephemeral streams. The lowering of the piezometric surface indicates that ground water discharge exceeds ground water recharge and small values of tritium and Carbon-14 ages of around 20,000 yr BP suggest that much of the ground water may be relict. While sufficient water is supplied to the power station and the mines of Jerada, agriculture has to expect smaller amounts of irrigation water in the future. Nomads too are affected by the drying up of small artesian springs. (See also W86-05679) (Author's abstract)
W86-05682

THERMAL ANOMALIES DUE TO INJECTION-WELL DISCHARGES IN POROUS AQUIFERS,

Zweckverband Landeswasserversorgung, Stuttgart (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W86-05683

MULTIPLE DEMAND AND CONFLICTS,

Wessex Water Authority, Bristol (England).
For primary bibliographic entry see Field 6D.
W86-05684

COMPLEX EFFECT OF SOME AGRONOMICAL PROCEDURES AND HYDROMETEOROLOGICAL FACTORS ON THE WATER BUDGET OF THE SOIL,

Debrecen Univ. of Agrarian Sciences (Hungary).
For primary bibliographic entry see Field 3F.
W86-05685

ANALYSIS OF USING GROUND WATERS IN DIFFERENT SECTORS OF THE ECONOMY,

Belorusskii Nauchno-Issledovatelskii Inst. Melioratsii i Vodnogo Khozyaistva, Minsk.
For primary bibliographic entry see Field 6D.
W86-05686

GROUNDWATER DEVELOPMENT AS AN INTEGRAL PART OF RIVER BASIN RESOURCE SYSTEMS,

Severn-Trent Water Authority, Birmingham (England).
A. Skinner.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 641-650, 2 fig, 5 ref.

Descriptors: *Groundwater potential, *Groundwater management, *Water resources development, *England, *Severn River, River basin development, Resources development, Resources systems, Resources management, Water management.

Groundwater in the UK is increasingly being used as an integral part of jointly operated resource systems. Groundwater offers a number of significant advantages in such methods of water resource management. These advantages are: lower unit cost, flexibility of development complementary to existing surface resources, and exploitation of resources that would not otherwise be used. These are demonstrated in the decision to prefer groundwater development to further surface storage in the river Severn catchment. The need for a broadly based investigation before major groundwater development schemes are promoted is emphasized. These investigations should include consideration of the environmental constraints. (See also W86-05679) (Lantz - PTT)
W86-05687

GROUND-WATER RESOURCES: PRINCIPLES FOR THEIR DEVELOPMENT AND UTILIZATION,

Belorusskii Nauchno-Issledovatelskii Inst. Melioratsii i Vodnogo Khozyaistva, Minsk.
V. Usenko.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 651-660, 4 tab, 16 ref.

Descriptors: *Groundwater potential, *Groundwater availability, *USSR, Groundwater recharge, Groundwater depletion, Groundwater storage, Natural waters, Water allocation, Transformation, Water regulation.

Data are presented on the distribution of fresh and groundwater resources over the USSR's territory and on the global scale together with their renewability characteristics in various parts of the hydrosphere. The principles of groundwater utilization are formulated. These are: 1) the principle of limited availability, 2) the principle of renewability, 3) the principle of unity and interrelation between natural waters, 4) the principle of transformation and regulation, and 5) the principle of rational allocation of productive sources. Groundwater resources and storage are also described. (See also W86-05679) (Lantz - PTT)
W86-05688

GROUNDWATER RESOURCES DEVELOPMENT AVOIDING CONFLICTS OF USAGE: EXAMPLES OF MODERN PLANNING STRATEGIES,

Ingenieurbuero Dr. Ing. G. Bjornsen, Kobenz (Germany, F.R.).
For primary bibliographic entry see Field 6D.
W86-05689

JOINT USE OF SURFACE WATER AND GROUND WATER OR LARGE AQUIFERS OF VOLCANIC ORIGIN (L'USAGE CONJOINT D'EAUX SUPERFICIELLES ET D'EAUX SOUTERRAINES DANS UN BASSIN OU L'ON A UN GRAND AQUIFERE CONSTITUE DE ROCHES VOLCANIQUES),

Catania Univ. (Italy). Ist. di Scienza della Terra.
For primary bibliographic entry see Field 6D.
W86-05690

MANAGING THE INTEGRATION OF GROUNDWATER AND SURFACE WATER RESOURCES: A CASE STUDY OF SUPPLYING POTABLE WATER TO THE LILLE METROPOLITAN AREA (GESTION INTEGREE DES RESSOURCES EN EAU SOUTERRAINE ET SUPERFICIELLE: LE CASE DE L'ALIMENTATION EN EAU POTABLE DE LA METROPOLE LILLOISE),

Bureau de Recherches Geologiques et Minieres, Lille (France). Service Geologique Regional Nord Pas-de-Calais.
For primary bibliographic entry see Field 6D.
W86-05691

NUMERICAL MODEL FOR OPTIMAL GROUNDWATER MANAGEMENT,

Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Wasserbau.
W. Bogacki, and W. Pelka.
IN: Groundwater in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 697-706, 5 fig, 4 ref.

Descriptors: *Numerical models, *Groundwater management, *Linear programming model, *Finite element model, Mathematical studies, Numerical analysis, Aquifers.

An optimization model is presented for optimal groundwater management, the basic idea of which is coupling a linear programming model and a finite element groundwater model (FEM). The LP-model includes several objective functions and a number of different hydrologic, economic and environmental constraints while the hydraulic response of the aquifer system is described by a FEM groundwater model. As an example for the application of the model, it is shown how a policy can be found for the dynamic development of a groundwater basin at minimal costs, satisfying all agricultural, environmental, economic and technical requirements at every stage of planning. (See also W86-05679) (Author's abstract)
W86-05692

ESTABLISHING THE OPTIMUM EXPLOITATION SOLUTIONS FOR A CONFINED AQUIFER,

Institutul de Meteorologie si Hidrologie, Bucharest (Romania).
M. Bretotean.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 707-716, 4 fig, 3 ref.

Descriptors: *Groundwater management, *Confined aquifers, *Groundwater depletion, *Exploitation, Mathematical models, Simulation analysis, Groundwater movement.

Discussed are methods employed in assessing the optimum solutions in the exploitation of a section in a multilayer aquifer under pressure having leakage links between its layers and being heavily drilled (several hundred wells). The optimum solution in exploitation, conditioned by the extraction of a maximum discharge maintaining the aquifer in use for an unlimited period of time and by the reduction of the piezometric surfaces for a long time at a certain rate, lies in the simulation of several exploitation variants on the mathematical model of water movement in nonpermanent regime within each layer belonging to the aquifer. (See also W86-05679) (Author's abstract)
W86-05693

CALIBRATION STRATEGY FOR GROUNDWATER MODELS,

For primary bibliographic entry see Field 2F.
W86-05694

PROGNOSTIC STUDY OF WATER LEVELS FOR EVALUATING THE HYDROGEOLOGICAL CHARACTER OF SHADNAGAR BASIN, (A.P.), INDIA,

Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
For primary bibliographic entry see Field 2F.
W86-05695

REGIONAL WATER RESOURCES SIMULATION WITH STREAM AQUIFER INTERACTION, SENSITIVITY ANALYSIS AND INVERSE MODELLING,

Indian Inst. of Tech., New Delhi.
For primary bibliographic entry see Field 2F.
W86-05696

ARTIFICIAL RECHARGE OF WATER LEVEL IN MOULLE (P OF C): AN EXAMPLE OF WATER RESOURCE MANAGEMENT(L'ALIMENTATION ARTIFICIELLE DE LA NAPPE DE MOULLE (P OF C): UN EXEMPLE DE GESTION DE LA RESSOURCE),

Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
G. Dassonville.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 765-775, 5 fig, 5 ref.

Descriptors: *Artificial recharge, *Water level, *Moulle, *Water resources management, Houlle, Drinking water, Surface-groundwater relations, Catchment basins, Aa River, Infiltration, Groundwater recharge, Mathematical models.

There are neither groundwater nor sufficient surface water resources in the Dunkerque area of France. Drinking water has been supplied for a century by a groundwater catchment 40 km away, at Houlle and Moulle, at the foot of the Artois hills. Groundwater resources were sufficient to satisfy the increasing demand till 1970 when it reached 15 million cu m/yr. It became necessary to make up the insufficient seasonal infiltration of rainfall and to build an artificial groundwater recharge plant. Raw water of the river Aa, is introduced after a complete treatment into basins for this re-infiltration. The capacity is 50,000 cu m/day. A mathematical model is used to optimize, every year after winter rainfall, the quantities of water to be introduced monthly into the basins. This could satisfy a demand which could increase to 100,000 cu m/day. With such a management of the quantities of water introduced into the soil it was also possible to improve the quality of the ground water resources. (See also W86-05679) (Author's abstract)
W86-05697

ECONOMETRIC SYSTEM MODEL FOR PLANNING AND MANAGEMENT OF GROUNDWATER RESOURCES,

Instituto Politecnico Nacional, Mexico City.
For primary bibliographic entry see Field 6D.
W86-05698

COMPARISON BETWEEN DIFFERENT METHODS OF ARTIFICIAL GROUND-WATER RECHARGE,

Tongji Univ., Shanghai (China). Dept. of Environmental Engineering.
H. Hantke.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 787-794, 3 fig, 1 tab, 7 ref.

Descriptors: *Artificial recharge, *Comparison studies, *Seepage trenches, *Infiltration basins, Groundwater recharge, Induced infiltration, Algal growth, Anisotropy, Infiltration rate.

Artifical ground water recharge, which can be regarded as a part of water purification, is integrated within three steps: 1) intake of river water, 2) water purification, and 3) groundwater recharge via infiltration basins. A new method for recharge, the seepage trench, is described as being 1 m wide, 4m or 6m deep and covered with sheets. It is filled with coarse sand with grain-size diameter 0.6-1.5 mm (d sub 10 = 0.6 mm; d sub 60 = 1.2 mm; k sub f = 0.005 m/s). In comparison with the basin, its advantages are that the sheets prevent an algal growth and that neither anisotropy of the soil nor the impermeability of layers close to the surface reduce the infiltration rate. Besides its high efficiency, its surface can easily be cleaned. (See also W86-05679) (Lantz-PTT)
W86-05699

ARTIFICIAL GROUNDWATER RECHARGE USING HIGH-WATERS OF STREAMS,

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Hydromechanik.
B. Herrling.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 795-804, 6 fig, 4 ref.

Descriptors: *Artifical recharge, *Streams, *Alps, Aquifers, Groundwater recharge, Infiltration, Water loss, Finite element method, Mathematical studies.

Artifical groundwater recharge with peak discharges of streams is investigated for a case study in the foreland of the Alps where valleys of the glacial period, filled with permeable sand and gravel sediments, make up important aquifers. Due to the great distance between the water table and the surface in some of these regions, the use of gravel-pits as storage and seepage basins has been proposed. The consequences downstream in the valley are explored with a time dependent, two dimensional horizontal finite element model which considers moving lateral boundaries. Preliminary results presented are: 1) an underground flood wave caused by artificial recharge is considerably smoothed after some distance from the infiltration area; 2) increased exfiltration into the streams will begin about 4 months after recharge starts; 3) nearly all the recharged water leaks out into the streams downstream as a consequence of the local situations, and 4) during low discharges in the streams, the outflow of groundwater is especially great (caused by the big potential difference). Further research has to be done to control the recharge in such a way that no negative consequences can result in the downstream valley. The numerical model is a useful tool for these investigations. (See also W86-05679) (Lantz-PTT)
W86-05700

EVALUATION OF LONG-TERM GROUNDWATER LEVEL MEASUREMENTS FROM THE HEINSCHENWALDE GROUNDWATER EXPLOITATION AREA,

Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
W. Hofmann, and K. Trippler.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 805-827, 10 fig, 5 ref.

Descriptors: *Groundwater levels, *Heinschenwalde, *Groundwater exploitation, Statistical methods, Statistical analysis, Regression analysis, Correlation analysis, Kolmogoroff-Smirnoff Test, Groundwater depletion, Groundwater management, Exploitation.

For the past 14 years, groundwater level measurements have been carried out in the Heinschenwalde groundwater exploitation area. Fluctuations from three selected observation wells were analyzed using statistical methods. Successful use of the statistical methods of correlation and regression computation, and also the application of the Kolmogoroff-Smirnoff Test was only possible in the Heinschenwalde investigation area because: 1) the investigation area is hydrogeologically relatively homogeneous, 2) the readings of one observation point was not influenced by groundwater withdrawal, and 3) readings were available for over 10 years before the commencement of groundwater withdrawal. By using correlation and regression analysis, the proportion generated through the withdrawal of groundwater by the waterworks was separated from the chronological sequence of the groundwater level measurement. With the statistical fluctuation taken into consideration, and a standard variation of + 0.14 m, groundwater drawdown generated by the waterworks was determined with certainty from January and/or March 1977. This partial result is of importance because critics of the groundwater exploitation project who maintained that groundwater withdrawal by the waterworks had already commenced several years beforehand, and that as a result there was a considerable groundwater drawdown, could now be successfully refuted. The computations gave groundwater drawdown as a function of time. The results attained could now be subjected to a deeper analysis, whereby groundwater withdrawal by the waterworks could be regarded as a long term pump test with variable withdrawals. (See also W86-05679) (Lantz-PTT)
W86-05701

SMALL MODELS FOR THE SIMULATION OF GROUNDWATER FLOW (MINIATURISATION DES MODELES D'ECOULEMENT SOUTERRAIN),

Paris-6 Univ. (France).
For primary bibliographic entry see Field 2F.
W86-05702

MODELLING OF THE PROCESSES OF SEEPAGE AND TRANSPORT OF DISSOLVED SOLIDS IN GROUNDWATER,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 5B.
W86-05703

MATHEMATICAL MODELS OF GROUNDWATER BASINS: THEIR APPLICATION FOR STUDY AND MANAGEMENT OF HYDROGEOLOGICAL PROCESSES,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2F.
W86-05704

DEVELOPMENT OF GROUNDWATER RESOURCES UNDER CONSIDERATION OF LEAKAGE FLOW IN THE HALTERNER SANDE, FEDERAL REPUBLIC OF GERMANY,

Technische Hochschule Aachen (Germany, F.R.). Lehrgebiet Hydrogeologie.
H. R. Langguth, H. G. Meiners, and H. Schaeben.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 865-876, 4 fig, 4 ref.

Descriptors: *Groundwater potential, *Groundwater availability, *Halterner Sande, *West Germany, *Groundwater management, Aquifers, Groundwater recharge, Groundwater level, Leakage, Infiltration, Exploitation.

For the purpose of improving water management, the interaction between groundwater levels and various components of the water budget in the western part of the aquifer system of the Halterner Sande (Federal Republic of Germany) were analysed A steady-state analysis by means of a finite difference groundwater model showed the close relation between the rate of pumpage and the rate of recharge as leakage and infiltrating water from creeks. The results of the analysis of the aquifer system and its water budget and the consequences for the groundwater management can be summarized as follows: 1) groundwater exploitation does not affect recharge conditions. Recharge rates remain constant under conditions of mean to high precipitation; 2) under natural conditions without groundwater exploitation, recharge rates are only balanced by discharge of baseflow and upward leakage; 3) small exploitation rates reduce the rates of baseflow and upward leakage; 4) a substantial increase in exploitation rates leads to further reduction of baseflow and leakage. This means that in addition to groundwater from the main aquifer, groundwater from the upper aquifer is also exploited, leading to an enlargement of areas with downward leakage flow; 5) an extreme case of ground-

water exploitation is given when baseflow is completely suppressed and leakage in the whole area is downward. This is the hydrological critical state for steady-state conditions. Further exploitation can then only be covered from storage of the aquifer; 6) the historic development of the aquifer shows generally that quantities of groundwater from creek areas and leakage areas can be gained so that the total amount of recharge into the aquifer is increased; 7) by water management planning the process of increasing the recharge rates can be usefully applied; and 8) a realistic groundwater management concept should allow for a minimal runoff (baseflow) and a minimum depth to water table in creek areas in order to maintain the character of vegetation and landscape. (See also W86-05679) (Lantz-PTT)
W86-05705

MANAGEMENT MATRIX FOR A REGIONAL AQUIFER IN THE UNITED KINGDOM,
Binnie and Partners, London (England).
For primary bibliographic entry see Field 6B.
W86-05706

3-D DIGITAL MODEL FOR GROUNDWATER MANAGEMENT,
ARMETED/JECOR, Jeddah (Saudi Arabia).
For primary bibliographic entry see Field 6B.
W86-05707

USE OF MATHEMATICAL PROGRAMMING IN THE MANAGEMENT AND DEVELOPMENT OF ISRAEL'S WATER RESOURCES,
Tahal Consulting Engineers Ltd., Tel-Aviv (Israel).
For primary bibliographic entry see Field 6B.
W86-05709

FIELD STUDIES ON THE INTERCHANGE OF SURFACE WATER AND GROUND WATER,
Institut fuer Wasser- und Abfallwirtschaft der Landesanstalt fuer Umweltschultz, Karlsruhe (Germany, F.R.).
R. Traub.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 931-939, 2 fig, 6 ref.

Descriptors: *Field tests, *Surface-groundwater relations, River basin development, Groundwater recharge, Infiltration, Stream inflow, Rhine River, Frequency analysis, Reservoirs.

In river development projects involving impoundment by dams information on the extent of settling is of great importance for the planning of concomitant measures for dam construction, such as design of lateral canals and infiltrating streams. The knowledge of this process is also essential from the aspect of ground water recharge by stream inflow and thus generally in the entire field of water resources development and management. In the project described here, direct and indirect measuring techniques have been developed and applied. Special attention is given to the presentation of direct methods used for measuring the extent of setting in two experimental areas. Preliminary results indicate that in some sections of the Rhine, without river impoundment by dams, an ideal colmatage depth varying between 320 m and 700 m was determined with the aid of frequency analysis. These results were late corroborated by computations made within the scope of another project with other model techniques. (See also W86-05679) (Lantz-PTT)
W86-05710

GROUNDWATER LEVEL MANAGEMENT IN THE PLAIN OF ALSACE IN MOYEN: MODEL SIMULATIONS AND INFORMATION EXCHANGE (GESTION DE LA NAPPE PHREATIQUE DE LA PLAINE D'ALSACE AU MOYEN D'UNE BANQUE DE DONNEES ET DE MODELS DE SIMULATION),
Bureau de Recherches Geologiques et Minieres, Strasbourg (France).
For primary bibliographic entry see Field 2F.
W86-05711

IMPLICATIONS OF THE USE OF REGIONAL GROUNDWATER MODELS: A CASE STUDY,
Groundwater Development Consultants, Cambridge (England).
For primary bibliographic entry see Field 6B.
W86-05712

TRANSIENT GROUNDWATER FLOW IN TWO AQUIFER SYSTEMS DUE TO CIRCULAR AND RECTANGULAR WELL FIELDS,
Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
Z. Weizhen.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 959-968, 2 fig, 7 ref.

Descriptors: *Groundwater movement, *Aquifer systems, Circular well fields, Rectangular well fields, Mathematical studies, Infiltration, Seepage, Leaky aquifers, Drawdown.

Well fields can usually be simplified as circular or rectangular in shape, and most of them withdraw groundwater from systems consisting of two or more aquifers separated by semi-confining layers. Therefore, the study of transient groundwater flow in two aquifer systems in response to uniform extraction from well fields, is of practical significance both for evaluation and planning of groundwater resources. Formulas to determine this flow are developed and presented. In the derivation, both drawdown in the neighboring aquifer, and storability in the semi-confining layer, have been considered. Simplified expressions and tables for the special functions involved in formulas are also given. (See also W86-05679) (Lantz-PTT)
W86-05713

INFLUENCE OF SILICATE GEL INJECTIONS ON GROUNDWATER QUALITY,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5B.
W86-05714

LARGE-SCALE EXPERIMENT OF IN SITU BIODEGRADATION OF HYDROCARBONS IN THE SUBSURFACE,
Ingenieurbuero Dr. Ing. G. Bjornsen, Kobenz (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W86-05715

ANALYSIS OF MIGRATION PROCESSES IN GROUNDWATER BY AID OF NUMERICAL MODELS,
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
For primary bibliographic entry see Field 5B.
W86-05716

PREVENTION OF ACCUMULATING NITRATES FROM AGRICULTURAL SOURCES IN GROUND WATERS (PREVENTION DE L'ENRICHISSEMENT DES EAUX SOUTERRAINES EN NITRATES D'ORIGINE AGRICOLE),
Ministere de l'Agriculture, Paris (France). Service de l'Hydraulique.
For primary bibliographic entry see Field 5G.
W86-05717

BIOLOGY OF AQUATIC MICROORGANISMS WHICH ARE POTENTIALLY PATHOGENIC TO MAN (ECOLOGIE DES MICROORGANISMES DE L'ENVIRONNEMENT AQUATIQUE SUSCEPTIBLES DE DEVENIR PATHOGENES POUR L'HOMME),
Strasbourg-1 Univ. (France).
For primary bibliographic entry see Field 5C.
W86-05718

POTABLE GROUNDWATER SUPPLIES AND LOW-COST SANITARY ENGINEERING: HOW COMPATIBLE,
Institute of Geological Sciences, Wallingford (England). Hydrogeology Unit.
For primary bibliographic entry see Field 5G.
W86-05719

DETECTION AND ASSESSMENT OF GROUNDWATER CONTAMINATIONS BY ORGANIC CHEMICALS,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5A.
W86-05720

IMPACT OF TECHNOGENETIC FACTORS AND WATER WITHDRAWAL ON HYDROCHEMICAL CONDITIONS OF WATER-BEARING SYSTEMS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 5B.
W86-05721

UNDERGROUND PURIFICATION CAPACITY,
Hessisches Landesamt fuer Bodenforschung, Wiesbaden (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W86-05722

METHOD OF WORKING AND EMPLOYMENT OF EDP DURING THE PREPARATION OF GROUNDWATER VULNERABILITY MAPS,
Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
For primary bibliographic entry see Field 7C.
W86-05723

POSSIBLE CHANGES IN GROUNDWATER QUALITY RESULTING FROM RIVER CHANNELIZATION AND IMPOUNDMENT,
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
For primary bibliographic entry see Field 5B.
W86-05724

EFFECT OF FERTILIZER USE ON GROUND WATER QUALITY IN INDIA,
Central Groundwater Board, Lucknow (India).
For primary bibliographic entry see Field 5B.
W86-05725

GEOLOGICAL AND HYDROGEOLOGICAL ASPECTS FOR PLANNING AND OPERATION OF DOMESTIC AND INDUSTRIAL WASTE DEPOSITS,
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Ingenier- und Hydrogeologie.
For primary bibliographic entry see Field 5G.
W86-05726

SURVIVAL OF SOME PATHOGENIC AND POTENTIAL PATHOGENIC BACTERIA IN GROUNDWATER,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5B.
W86-05727

APPLICATION OF CONTAMINANT ARRIVAL DISTRIBUTIONS TO THE SIMULATION AND DESIGN OF HYDRAULIC DECONTAMINATION MEASURES IN POROUS AQUIFERS,
Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.

For primary bibliographic entry see Field 5G.
W86-05728

GROUND-WATER POLLUTION BY NITRATE,

Bremer Umweltinstitut fuer die Analyse und Bewertung von Schadstoffen (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W86-05729

POLLUTION OF GROUNDWATER FROM DIFFUSE SOURCES,

Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W86-05730

PRESENT STATE AND PERSPECTIVES OF REGULAR GROUND-WATER QUALITY MONITORING IN SLOVAKIA,

Slovak Hydrometeorological Inst., Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 5G.
W86-05731

HYDROCHEMICAL MAPS AS BASIC INFORMATION FOR THE PROTECTION OF GROUNDWATER,

Grosser Erftverband, Bergheim (Germany, F.R.).
For primary bibliographic entry see Field 7C.
W86-05732

VOLUNTARY COOPERATION FOR THE EXPLORATION OF GROUND WATER (COOPERATEURS VOLONTAIRES POUR L'EXPLORATION DES EAUX SOUTERRAINES),

E. Sobotha.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1203-1207, 3 fig, 4 ref.

Descriptors: *Exploration, *Groundwater potential, *Voluntary cooperation, Groundwater availability, Yield, Wells, Springs, Chemical properties, Water supply.

In view of the few places suitable for a survey and control of ground water, a group of voluntary workers was organized. They were high school students participating in the contest 'Jugend Forscht'. With simplified methods, they studied the yield and temperature of springs and wells. They also investigated chemical properties which give information about the origins and paths of water, and they determined the deviation range. But the requirements have not yet been met to utilize these results. (See also W86-05679) (Author's abstract)
W86-05733

GROUNDWATER STUDIES FOR LIMA, PERU,

Binnie and Partners, London (England).
For primary bibliographic entry see Field 2F.
W86-05752

DISTRIBUTED CONJUNCTIVE USE MODEL FOR OPTIMAL CROPPING PATTERN,

Roorkee Univ. (India). School of Hydrology.
D. Kashyap, and S. Chandra.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 377-384, 1 fig, 2 tab, 5 ref.

Descriptors: *Groundwater management, *Water conservation, *Irrigation, *Conjunctive use, Water management, Daha, India, Model studies, Mathematical models, Krishni-Hindon basin, Water supply, Nonlinear programming, Spatial distribution, Temporal distribution, Groundwater depletion.

A mathematical model has been developed for arriving at an optimal conjunctive use policy incorporating (a) spatially and temporally distributed groundwater withdrawals for a predefined pattern of surface water availability and (b) spatially distributed cropping patterns. The groundwater withdrawals are constrained by the need to keep the water table elevations over the entire area within an appropriate range. The implicit nature of these constraints is taken care of by solving the problem within the framework of nonlinear programming. The model was applied to the Daha area of India. The entire area was divided into two zones of nearly similar hydrological conditions. The monthly groundwater withdrawals and areas under seven feasible crops were estimated for each zone by nonlinear programming. The objective function representing the net benefits from agricultural activity was maximized subject to 43 constraints which ensure, among other things, confinement of the depth to water table to 18 m and fulfillment of the crop water requirements. (See also W86-05750) (Author's abstract)
W86-05786

NEW TRITIUM INTERFACE METHOD FOR DETERMINING THE RECHARGE RATE OF DEEP GROUNDWATER IN THE BAVARIAN MOLASSE BASIN,

Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
For primary bibliographic entry see Field 2F.
W86-05837

ARTESIAN AND ANISOTROPIC EFFECTS ON DRAIN SPACING,

Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics.
A. S. Bazaraa, M. S. Abdel-Dayem, A. Amer, and L. S. Willardson.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 1, p 55-64, February 1986. 4 fig, 1 tab, 13 ref.

Descriptors: *Confined aquifers, *Artesian flow, *Anisotropy, *Drain spacing, *Drainage engineering, Drainage systems, Hydraulics, Conductivity, Hydraulic properties.

Subsurface drainage systems installed in the soil overlying artesian aquifers, should be spaced to handle both upward artesian water flow and normal downward seepage flow from irrigation and rainfall. Proper drain spacing depends on several parameters, while a narrower than normal spacing is required for drains subject to artesian conditions. The hydraulic conductivity of the soil above an artesian aquifer determines the ease with which water flows to the drains and the magnitude of the upward artesian water flux for a given piezometric head and soil layer thickness. Since water movement to subsurface drains depends on both the horizontal and vertical components of hydraulic conductivity, anisotropy of the soil affects the drain spacing. For most soil formations, the hydraulic conductivity in the horizontal direction exceeds that in the vertical direction. Neglecting anisotropy may lead to under-design of the drainage system for a formation above an impermeable layer and can lead to over-design of a drain system for a formation subject to artesian conditions with no downward flow. For a soil subject to upward flow as well as downward flow, anisotropy effects depend on the magnitude of the different parameters influencing the problem. (Authors' abstract)
W86-05927

ABSTRACTION AND RECHARGE WELL IN UNIFORM SEEPAGE,

Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydrology JHYDA7, Vol. 80, No. 1/2, p 1-8, September 1985. 4 fig, 5 ref.

Descriptors: *Groundwater recharge, *Recharge wells, *Underground storage, Seepage, Flow patterns, Aquifers, Wells.

Recharge wells may be located close upstream to an abstraction well, if the aquifer is being used as a storage reservoir, or at a distance downstream, if recovery of injected water is not desired. When the recharge well is directly upstream from the abstraction well, three relatively simple streamline patterns are possible, with abstracted flow rate equal to, in excess of, or less than recharge flow rate. When the recharge well is downstream from the abstraction well, four different, and more complicated, streamline patterns are possible. Classifications are given which make possible the calculation of the steady-state concentration in the abstraction well in terms of the concentrations of the recharge water and of the incoming flow. (McFarlane-PTT)
W86-05986

SOME ANALYTICAL SOLUTIONS FOR SEAWATER INTRUSION CONTROL WITH RECHARGE WELLS,

Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
B. Hunt.
Journal of Hydrology JHYDA7, Vol. 80, No. 1/2, p 9-18, September 1985, 5 fig, 9 ref.

Descriptors: *Seawater intrusion, *Recharge wells, *Coastal aquifers, Saline water barriers, Saline-freshwater interfaces, Seawater, Mathematical analysis.

Water abstraction from any coastal aquifer lowers piezometric-head levels in the aquifer and may result in seawater intrusion. The use of recharge wells to control seawater intrusion is an expensive operation. Closed-form solutions are obtained for the steady-state location of the saltwater interface and stagnation points when either a single recharge well or an infinite number of recharge wells are used to inject freshwater into a coastal aquifer. The solutions can be applied to either confined or unconfined flows. (McFarlane-PTT)
W86-05987

PRINCIPLES AND LAW OF COLORADO'S NONTRIBUTARY GROUND WATER,

For primary bibliographic entry see Field 6E.
W86-05991

HYDROLOGIC BUDGET ANALYSIS FOR THE NILE VALLEY IN EGYPT,

Ministry of Irrigation, Cairo (Egypt). Research Inst. for Groundwater.
For primary bibliographic entry see Field 2F.
W86-06168

GROUND-WATER DAMS FOR RURAL-WATER SUPPLIES IN DEVELOPING COUNTRIES,

Viak AB, Vallingby (Sweden).
For primary bibliographic entry see Field 8A.
W86-06174

RECOVERING FRESH WATER STORED IN SALINE LIMESTONE AQUIFERS,

Geological Survey, Miami, FL. Water Resources Div.
M. L. Merritt.
Ground Water GRWAAP, Vol. 24, No. 4, p 516-529, July-August 1986. 11 fig, 1 tab, 24 ref.

Descriptors: *Water storage, *Aquifers, *Limestone, Numerical analysis, Mathematical modeling, Sensitivity analysis, Injection, Hydraulic gradients, Flow patterns, Chlorides, Salinity, Permeability, Water management.

Numerical modeling techniques are used to examine the hydrogeologic, design, and management factors governing the recovery efficiency of subsurface fresh water storage. The modeling approach permitted many combinations of conditions to be studied. A sensitivity analysis was used that consisted of varying certain parameters while keeping constant as many other parameters or processes as possible. Generally, the study shows that a loss recovery efficiency resulted from: (1) processes causing mixing of injected fresh water with native saline water (hydrodynamic dispersion); (2) processes or conditions causing the irre-

versible displacement of the injected fresh water with respect to the well (buoyancy stratification and background hydraulic gradients); and (3) processes or procedures causing injection and withdrawal flow patterns to be dissimilar (dissimilar injection and withdrawal schedules in multiple-well systems). A significant result is the theoretical demonstration that recovery phase ends when the chloride concentration of withdrawn water increases to some prescribed value less than that of the more-saline native water. Other results show that a high degree of aquifer permeability or high salinity of the native water, or a combination of these factors, would permit rapid buoyancy stratification and bring about a substantial loss of recovery efficiency. (Lantz-PTT)
W86-06176

4C. Effects On Water Of Man's Non-Water Activities

ANALYTICAL MODELING OF GROUNDWATER IMPACTS BY MINING,

Koch and Associates, Denver, CO.
D. Koch.
Ground Water GRWAAP, Vol. 24, No. 2, p 224-230, march-April, 1986. 11 fig, 7 ref.

Descriptors: *Groundwater management, *Groundwater movement, *Excavation, *Mine drainage, Model studies, Algorithms, Geohydrology, Drawdown, Water level, Water table.

An equation for two-dimensional, vertically averaged steady-state flow to a finite length line sink, a semiempirical expression for the radius of influence,and the theory of superposition are used to predict the impacts of mining excavations on groundwater flow patterns. The algorithm provides a rapid method for estimating the inflow to mine pits, and the impact of mines on the potentiometric surface. An accurate expression for the radius of influence is developed by comparison with analytical and finite-difference model solutions. The algorithm also has applications in the simulation of drainage lines. The usual assumption of infinite-length drainage lines may be relaxed and the effectiveness of proposed drainage systems simulated in two dimensions. (Cassar-PTT)
W86-05448

EFFECTS OF COAL-FIRED THERMAL POWER PLANT DISCHARGES ON AGRICULTURAL SOIL AND CROP PLANTS,

Aligarh Muslim Univ. (India). Environmental Research Lab.
For primary bibliographic entry see Field 5C.
W86-05573

DRINKING WATER SUPPLY MANAGEMENT: AN INTERACTIVE APPROACH,

Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
For primary bibliographic entry see Field 5G.
W86-05575

LOSS OF PRODUCTIVE SOIL IN INDIA,

Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
For primary bibliographic entry see Field 4D.
W86-05578

FORESTS, MAN AND WATER,

King's Coll., London (England). Dept. of Plant Sciences.
P. D. Moore.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 3, p 159-166, July 1985. 1 fig, 41 ref.

Descriptors: *Deforestation, *Soil erosion, River basins, Hydrologic cycle, Flooding, Forest hydrology, Land clearing.

The overall effect of a forest canopy on its immediate environment is discussed, followed by a review of studies of forest clearance, and a discussion of the effect of forest clearance on erosion of soils. After discussing the disturbance of the ecosystem by man in prehistoric times, it is asserted that the hydrologic impact of man, even in prehistoric times, was so great that even climatic changes in the hydrologic cycle may have been masked. Lessons for the future development of the Amazon basin and river catchments in equatorial Africa are offered. (Author's abstract)
W86-05589

PREDICTION OF UNDERGROUND WATER REGIME AND BALANCE IN LANDS UNDER RECLAMATION,

Y. G. Bogomolov, V. A. Baron, D. M. Katz, and M. F. Kozlov.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. 25-31, 10 ref.

Descriptors: *Groundwater, *Geohydrology, *Land reclamation, *Land use, *Prediction, Regional analysis, Models, Hydrologic budget, Planning, Drainage basins, Irrigation programs, Chemical properties, Hydrologic models, Statistical methods, Seepage, Groundwater movement, Water resources development.

To predict the underground water regime on the basis of the results of medium-scale hydrogeological and engineering geological exploration, the drainage degree of the study area is estimated by a hydrodynamic model. A regional prediction of the underground water regime needed to substantiate the scheme of land reclamation measures is executed on the basis of preliminary estimation of the existing drainage degree of the area under consideration, land reclamation measures planned in it, and investigation results in separate water-balance plots. Depending on the actual hydrogeological conditions and planned land reclamation measures, groundwater regime prediction should take the following into account: prediction of the groundwater regime of previously developed areas in connection with the projected reconstruction of the irrigation or drainage network, changes in crop rotation, dynamics of groundwater rise as a result of irrigation under the existing conditions of drainage, and other factors such as mineralization, chemical composition, groundwater surface, and salination of swamping. Existing methods to predict groundwater regime may be subdivided into water-balance, hydrogeological analogy and hydrodynamic, the latter encompassing analytic, numerical and analogue modelling. The hydrodynamic methods make it possible to reproduce the conditions of the groundwater regime formation in great detail and thus are fundamental to any hydrogeological substantiation of land reclamation. (See also W86-05645) (Geiger - PTT)
W86-05648

VARIATION OF THE GROUNDWATER REGIME UNDER THE EFFECTS OF HUMAN ACTIVITIES AND ITS ARTIFICIAL CONTROL,

Ministry of Geology and Minerals, Beijing (China). Bureau of Hydrogeology and Engineering Geology.
J. Chuanmao.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 87-96, 8 fig, 2 tab.

Descriptors: *Groundwater recharge, *Groundwater mining, *Artificial recharge, *Groundwater level, *Irrigation wells, Water resources development, Environmental effects, Groundwater management, Infiltration, Groundwater movement, China.

In the arid and semiarid parts of north China, groundwater resources have been developed to varying extents. It is very important to study and estimate the process of transformation from a natural to a disturbed groundwater regime. Optimal extraction can reduce the water levels during the spring months and decrease evaporation from the water table. It follows then that the underground reservoir has greater capacity for holding infiltrated water during rainy months. Detailed study of the recharge and extraction of groundwater in irrigated areas enables determination of the optimal quantity of pumped water and the corresponding water level fluctuation during years with various precipitation. Artificial recharge of groundwater by means of irrigation networks, pits and wells had a positive effect in several areas and these methods can be used in territories with similar conditions. (See also W86-05645) (Author's abstract)
W86-05654

EFFECTS OF LAND-USE CHANGES ON GROUNDWATER RECHARGE ASSESSED USING A NONLINEAR CATCHMENT MODEL,

Newcastle upon Tyne Univ. (England). Dept. of Civil Engineering.
L. R. Khan, and J. A. Mawdsley.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 97-106, 5 fig, 2 tab, 19 ref.

Descriptors: *Groundwater recharge, *Aquifers, *Model studies, *Land use, *Soil moisture, Models, Hydrologic models, Groundwater basins, Groundwater storage, Urbanization, Catchment areas, Runoff, Infiltration, Water resources development, Hampshire, England, Hydrologic properties.

Daily groundwater recharge for almost 20 years was computed for the unconfined aquifer of the Itchen basin in Hampshire, UK, using a version of the NWSRFS (i.e., Sacramento) model - a nonlinear, conceptual, explicit soil moisture accounting model. The groundwater recharge was equated to the water entering the groundwater storage zones, two of a series of storage zones related to the various components of the land phase of the hydrologic cycle. Many of the model parameters were estimated from the physical characteristics of the basin; the remainder were initially optimized using a conventional surface water objective function, and finally optimized using an objective function linked to the groundwater component of the model. The effects of land use changes which affect the hydrologic characteristics of the basin and hence the recharge to the groundwater - e.g., changes in agriculture practices or urbanization were investigated by changing the relevant model parameters. (See also W86-05645) (Author's abstract)
W86-05655

SYSTEMATIC DECLINE OF GROUNDWATER LEVEL IN THE REGOLITHS OF THE NIGERIAN BASEMENT COMPLEX DUE TO HUMAN ACTIVITIES,

Ife Univ. (Nigeria). Dept. of Geography.
E. O. Omorinbola.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 111-119, 3 fig, 3 tab, 17 ref.

Descriptors: *Groundwater level, *Groundwater recharge, *Urbanization, *Groundwater mining, *Erosion, Regression analysis, Aquifers, Natural recharge, Geohydrology, Land use, Groundwater depletion, Groundwater recession, Saturation zone, Nigeria, Statistical studies, Social impact, Economic impact.

Thick weathered mantles overlying crystalline rocks constitute the most significant domains of

groundwater resources in the Nigerian Basement Complex. A recent geohydrological study of parts of southwestern Nigeria revealed that a systematic lowering of the groundwater level in the regoliths is taking place. The decline was established under three types of human interference: high-level urbanization that limits groundwater recharge through an increased proportion of impermeable surface; clearing of interfluves for farmland that results in accelerated erosion of regoliths by fluvial processes; and uncontrolled well-sinking operations in rural communities whereby the rate of groundwater abstraction exceeds the rate of natural recharge. Least-squares regression techniques were applied to obtain prediction equations of the life span of the regolith aquifers. (See also W86-05645) (Author's abstract)
W86-05657

ASSESSMENT OF THE EFFECTS OF LAND USE ON GROUNDWATER RECHARGE,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
H. S. Wheater, D. J. Sherratt, and S. S. Nwabuzor.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 135-147, 5 fig, 3 tab, 10 ref.

Descriptors: *Land use, *Groundwater recharge, *Natural recharge, *Hydrologic models, *Vegetation effects, Model studies, Soil water, Hydrologic budget, Models, Groundwater movement.

The volume and timing of natural recharge is largely determined by the dynamic processes of soil water movement under vegetation, and hence may be significantly affected by changes in land use. The capability of a conventional soil water budget model to represent the water balance under different vegetation is reviewed by comparison with field data. Although model optimization gives reasonable simulation of soil moisture expressed as a deficit with respect to field capacity, the model is unable to predict observed summer recharge. Introduction of a direct recharge component also gives significant errors in recharge distribution. The concept of a single field capacity to represent a dynamic soil water profile is shown to explain the model deficiency, and the implications for the estimated effects of land use change are discussed. It is concluded that a more complex multi-layer model is required to assess such effects more accurately. (See also W86-05645) (Author's abstract)
W86-05660

POLLUTION OF GROUNDWATER FROM DIFFUSE SOURCES,
Umweltbundesamt, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W86-05730

MONETARY VALUATION OF TIMBER, FORAGE, AND WATER YIELDS FROM PUBLIC FOREST LANDS,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ.
For primary bibliographic entry see Field 6C.
W86-05749

RESPONSE OF BAETIS MAYFLIES (EPHEMEROPTERA) TO CATCHMENT LOGGING,
Georgia Univ., Athens. Dept. of Entomology.
J. B. Wallace, and M. E. Gurtz.
The American Midland Naturalist, Vol. 115, No. 1, p 25-41, January 1986. 4 fig, 4 tab, 50 ref.

Descriptors: *Mayflies, *Baetis spp., *Catchment areas, *Logging, *Aquatic insects, Forest management, Clear-cutting, Stream biota, Biomass, Primary productivity.

Following clear-cutting of a southern Appalachian hardwood catchment, standing stock densities and biomass of Baetis spp. increased in four stream substrate types (rock face, cobble riffle, pebble riffle, and sandy reach) compared to those of a nearby undisturbed reference stream. Baetis production in the stream draining the clear-cut catchment averaged 17.6 times higher than that of the reference stream, and up to 27.6 times that of the reference stream in the more physically stable rock-face substrates. Sampling four and five years following the clear cut indicates significant declines in Baetis populations of the clear-cut stream that coincided with a 10-fold decrease in primary productivity. Although characterized by short, multivoltine life cycles and high fecundity, Baetis spp. comprise a minor component of the standing stock biomass in most headwater streams of the region. However, with disturbances such as clear-cutting, they respond quickly to exploit increases in autochthonous production, and assume major roles in energy processing. In contrast, larger, less fecund univoltine and semivoltine species lack the ability to respond quickly and exploit the relatively short-lived increases in primary production. (Doria-PTT)
W86-05931

HISTORY OF DRAINAGE AT WICKEN FEN, CAMBRIDGESHIRE, ENGLAND, AND ITS RELEVANCE TO CONSERVATION,
Cambridge Univ. (England). Dept. of Applied Biology.
For primary bibliographic entry see Field 2H.
W86-05934

EFFECT OF AGRICULTURAL AND RESIDENTIAL DEVELOPMENT ON AQUATIC MACROPHYTES IN THE NEW JERSEY PINE BARRENS,
Rutgers - The State Univ., Camden, NJ. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-05935

SOIL ALGAE IN POLLUTED SOILS,
Kirovskii Selskokhozyaistvennyi Inst. (USSR).
For primary bibliographic entry see Field 5C.
W86-06010

RUN ANALYSIS OF RAINFALL DATA AFFECTED BY URBANIZATION,
Hydrocon, Inc., Clarkston, GA.
For primary bibliographic entry see Field 2B.
W86-06166

STRATA-MOVEMENT CONCEPTS AND THE HYDROGEOLOGICAL IMPACT OF UNDERGROUND COAL MINING,
Northern Illinois Univ., De Kalb. Dept. of Geology.
C. J. Booth.
Ground Water GRWAAP, Vol. 24, No. 4, p 507-515, July-August 1986. 11 fig, 1 tab, 23 ref.

Descriptors: *Geohydrology, *Coal mining, *Stratigraphy, Hydraulic properties, Groundwater, Permeability, Aquifers, Hydraulic gradients, Pennsylvania, Appalachia, Tensile stress, Mine drainage, Stress.

A review of mining-engineering concepts and studies in mine hydrology suggests a conceptual model linking the strata deformation, hydraulic property changes, and groundwater impacts due to underground coal mining. The pressure-arch deformation pattern about a small opening creates a local zone of increased permeabilities and dewatering in the seam and immediate roof, but does not appear to hydraulically affect shallower aquifers. Networks of supported headings, rooms, and pillars intensely drain lower aquifers, only slightly affecting higher strata except in areas of naturally high permeability. Longwall mining causes extensive, high reaching, well defined zones of stress, fracturing, and hydraulic impact, with maximum permeability increases being in the tensile zones immediately above the panel and at the sides of the subsidence trough. In shallow aquifers, permeabilities and groundwater velocities increase, and hydraulic gradients decline independently of mine drainage. Studies conducted in a deep coal mine in the Appalachian Plateau, Pennsylvania indicated: 1) probable hydraulic connections between the mine and shallow aquifers; 2) no obvious response of water levels in shallow aquifers to undermining by supported headings; and 3) rapid, considerable declines in such water levels in response to nearby longwall mining. These results are consistent with the conceptual model. (Author's abstract)
W86-06175

4D. Watershed Protection

LOSS OF PRODUCTIVE SOIL IN INDIA,
Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences.
K. Jalees.
International Journal of Environmental Studies IJEVAW, Vol. 24, No. 3/4, p 245-250, May 1985. 2 tab, 21 ref.

Descriptors: *Soil erosion, *India, *Food production, *Waterlogging, *Salinity, *Alkalinity, *Wind erosion, *Water erosion, China, Deforestation, Overgrazing, Irrigation, Urbanization, Policy making, Soil loss.

An attempt is made to indicate the nature and magnitude of 'soil erosion' in India, which may have implications for other countries of the world. Approximately 175 million hectares, out of a productive area of 328 million hectares, are affected, as follows: water erosion, 100 million ha; wind erosion, 50 million ha; waterlogging, salinity, and alkalinity, 13 million ha; shifting cultivation, 3 million ha; and other cultivable wastes, 9 million ha. Soil erosion is a pressing and difficult problem for India. If present trends continue, all efforts aimed at producing more food may not compensate for the areas lost as a result of soil degradation. India can barely manage to produce 130 million tonnes of food grain from 143 million ha of agricultural lands, whereas China produces significantly more than 300 million tonnes from 112 million ha. By the end of this century, the country will need a production of at least 230-250 million tonnes. To ensure adequate food for the country's expanding population, present rates of soil erosion cannot be continued. Deforestation, overgrazing, excessive cultivation, unwise irrigation, and urbanization all will have to be controlled. Soil conservation and other forms of agriculture development must receive priority in national planning. (Rochester-PTT)
W86-05578

ECONOMICAL AND EFFECTIVE MEASURES FOR LAKE PROTECTION AND MANAGEMENT,
Illinois State Water Survey Div., Champaign.
K. Singh, and D. Sefton.
Public Works, Vol.116, No. 9, p 132-134,136,138-139, September 1985. 3 fig, 2 tab, 10 ref.

Descriptors: *Lake morphology, *Lake management, *Economic aspects, *Watershed management, Illinois, Recreation, Water supply, Artificial lakes, Lakes, Dredging, Sediments, Water quality, Control.

Lakes used for water supply, recreation and other beneficial uses require careful watershed management. There are 2900 lakes in Illinois, most of which are artificial reservoirs. Almost 80 percent of the lakes are reported to be impaired by sediment, macrophytes, algae or toxics, mainly due to high concentrations of phosphorus and nitrogen. The quality of artificially constructed lakes is primarily governed by the physical and hydrological characteristics of the lake and the quality of incoming watershed runoff. Discussed here are: 1) lake management techniques (dredging, admission of unpolluted water, hypolimnetic drainage, lake drawdown, lake bottom sealing, and outside-lake ameliorative measures); 2) mitigating sediment problems (watershed management, debris and detention dams, and dam design and lake management); 3) mitigating algae and macrophyte problems; 4) mitigating dissolved oxygen depletion problems; and desirable lake characteristics (physi-

cal, cultural and planning/design/operation). (Khumbatta-PTT)
W86-05880

ESTIMATING PEAK RUNOFF FROM FIELD-SIZE WATERSHEDS,

Agricultural Research Service, Columbia, MO. North Central Watershed Research Unit.
For primary bibliographic entry see Field 2E.
W86-06021

REVISION OF THE CHURCHILL RESERVOIR TRAP EFFICIENCY CURVES USING SMOOTHING SPLINES,

California Univ., Los Angeles. Dept. of Mathematics.
For primary bibliographic entry see Field 2J.
W86-06026

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

MORPHOLOGY AND CONTENT OF DRY MATTER AND SOME ELEMENTS IN CELLS AND STALKS OF NEVSKIA FROM AN EUTROPHIC LAKE,

Bergen Univ. (Norway). Dept. of Microbiology and Plant Physiology.
M. Heldal, and O. Tumyr.
Canadian Journal of Microbiology CJMIAZ, Vol. 32, No. 2, p 89-92, February 1986. 4 fig, 1 tab, 17 ref.

Descriptors: *Lake morphology, *Dry matter, *Nevskia, *Eutrophic lakes, Bacteria, Organic matter, Iron, Gallionella, Aluminum, Plankton, Lake Hjortlandsstemma, Norway.

Pelagic colonies of Nevskia-like stalked bacteria were found in water samples from Lake Hjortlandsstemma at 8-12 m depth during the autumn circulation. In the samples studied, Nevskia was quite abundant and found together with a planktonic Gallionella. The apical cells of Nevskia were curved rods, which measured 0.5-0.7 micrometers wide and 1.5-3 micrometers long, with laterally excreted stalkes and without measurable amounts of iron in the cells. The stalks were short and, in some instances, composed of six to eight strands of fibrils. The stalks were also encrusted with iron, aluminum, and other elements. The dry matter content of the cells was 260-350 femtograma/cell, while the organic material excreted as stalks was estimated to be 500-1200 femtograma/cell. The Nevskia described here is morphologically related to the genus Gallionella. (Lantz-PTT)
W86-05419

ENUMERATION AND IDENTIFICATION OF HETEROTROPHIC BACTERIA IN GROUNDWATER AND IN A MOUNTAIN STREAM,

Calgary Univ. (Alberta). Kananaskis Centre for Environmental Research.
For primary bibliographic entry see Field 2H.
W86-05420

QUANTITATIVE CHARACTERIZATION OF MICROBIAL BIOMASS AND COMMUNITY STRUCTURE IN SUBSURFACE MATERIAL: A PROKARYOTIC CONSORTIUM RESPONSIVE TO ORGANIC CONTAMINATION,

Florida State Univ., Tallahassee. Dept. of Biological Science.
G. A. Smith, J. S. Nickels, B. D. Kerger, J. D. Davis, and S. P. Collins.
Canadian Journal of Microbiology CJMIAZ, Vol. 32, No. 2, p 104-111, February 1986. 1 fig, 5 tab, 41 ref. EPA Agreement No. CR-86-9994.

Descriptors: *Quantitative analysis, *Biomass, *Ecosystems, *Subsurface water, *Soil environment, *Prokaryotes, *Water pollution effects, Microbiological studies, Chemical analysis, Esters, Phospholipids, Limestone, Sand, Clays, Biosynthesis.

The application of quantitative methods for the determination of microbial biomass, community structure, and nutritional status of the subsurface samples collected, with careful attention to contamination, revealed the presence of a group of microbes. The microbiota is sparse, by several measures of biomass when compared with that present in surface sediments and soils. The community structure, as characterized by the patterns of ester-linked fatty acids from the phospholids, shows an absence of long-chain polyenoic fatty acids typical of microeukaryotes, and high proportions of fatty acids typical of bacteria. Subsurface samples contain higher proportions of glycerol teichoic acids than surface samples. Microbes in uncontaminated subsurface sediments show nutritional stress, as evidenced by high levels of poly-beta-hydroxybutyrate and extracellular polysaccharides. The proportions of ester-linked phospholipid fatty acids show distinctive differences between surface and subsurface, between subsurface sandy clay and limestone, and between two sites of subsurface sandy clay, as shown using stepwise discriminant analysis. Contamination increased the microbial biomass, shifting the community to a more gram-negative bacterial consortium, and inducing growth, as evidenced by phospholipid fatty acid biosynthesis. (Lantz-PTT)
W86-05421

FLOCCULATION IN METHANOGENS, A COMPARATIVE STUDY OF METHANOSARCINA BARKERI STRAINS JULICH AND FUSARO,

Hamburg Univ. (Germany, F.R.). Inst. fuer Allgemeine Botanik.
P. A. Scherer, H. -P. Bochem, J. D. Davis, and D. C. White.
Canadian Journal of Microbiology CJMIAZ, Vol. 32, No. 2, p 137-144, February 1986. 4 fig, 1 tab, 47 ref. Office of Naval Research Contract N00014-82-C-0404 and NASA Grant NAG2-149.

Descriptors: *Flocculation, *Methanosarcina barkeri, *Methane bacteria, Culturing techniques, Microbiological studies, Electron microscopy, Mannose, Glucose, Fucose, Calcium.

Two strains of Methanosarcina barkeri grown on a methanol substrate were investigated for their ability to aggregate. The new, flocculent strain Julich formed stable flocs of several millimeters in diameter during rapid growth on methanol-containing medium. When observed with an electron microscope, the Julich strain showed a unique parenchymatic texture with thick-walled cells inside a floc, and coccoidlike cells on the periphery. In contrast in the Julich strain, the Fusaro strain grew on methanol in dispersed form, and generating macroscopically visible clumps only under poor growth conditions, induced, for example, by calcium deficiency. The formation of large cell aggregations of the Fussaro strain could also be induced during growth in the presence of 0.01% of the stain Calcofluor, which is known to interact specifically with beta-1,4 and beta-1,3 glucan moieties. Sugar analyses revealed a different pattern for both strains: the exopolymer of the flocculent Julich strain contained half the rhamnose, a third the fucose, equal amounts of the mannose and glucose, but four times more glucuronic acid and arabinose than the Fusaro strain grown in the dispersed form. (Lantz-PTT)
W86-05422

ISOLATION OF LEGIONELLA PNEUMOPHILA FROM CANADIAN HOT SPRINGS,

National Water Research Inst., Burlington (Ontario).
B. J. Dutka, and P. Evans.
Canadian Journal of Public Health, Vol. 77, No. 2, p 136-148, Mar/Apr 1986. 1 tab, 14 ref.

Descriptors: *Bacteria, *Hot springs, *Legionella pneumophila, Canada, Culture media, Culturing techniques, Fluorescence.

The occurrence of Legionella pneumophila in water of the Fairmont, Radium, and Banff hot springs was studied using culture and direct fluorescent antibody (DFA) techniques. All yielded evidence of Legionella, two by culture and one by DFA. The results show the value of using more than one king of medium (four were used in this survey). Although each of the media supported growth of Legionella from at least one water sample, no single medium would have recovered the organism from all culture-positive tests. It is concluded that hot springs are potential sources of Legionella although no obvious aerosol or other means of dissemination of organisms is present in these hot springs baths. (Peters-PTT)
W86-05450

ENVIRONMENTALLY SIGNIFICANT VOLATILE ORGANIC POLLUTANTS IN HUMAN BLOOD,

New Orleans Univ., LA. Center for Bio-Organic Studies.
S. R. Antoine, I. R. DeLeon, and R. M. O'Dell-Smith.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 3, p 364-371, March 1986. 2 fig, 1 tab, 11 ref.

Descriptors: *Drinknig water, *Well water, *Human blood, *Aromatic compounds, *Halogenated organics, Benzene, Toluene, Ethylbenzene, Volatile organics screening tests, Styrene, Xylene, Trimethylbenzene, Dichloromethane, Chloroform, Carbon tetracholride, 1,1,1-trichloroethane, Trichloroethylene, 1,1,2,2-tetrachloroethane, Tetrachloroethylene, Bromoform, Bromodichloromethane, Dibromochloromethane, Dichlorobenzene, Toxins, Pollutants.

Detection of the presence of 18 organic solvents and vapors was attempted in the whole blood of 121 male and 129 female environmentally-sensitive patients using the volatile organics screening test (VOST). Whole blood specimens were screened for 6 aromatics (benzene, toluene, ethylbenzene, styrene, xylene, and trimethylbenzene) and 12 halogenated hydrocarbons (dichloromethane, chloroform, carbon tetrachloride, 1,1,1-trichloromethane, trichloroethylene, 1,1,2,2-tetrachloroethane, tetrachloroethylene, bromoform, bromodichloromethane, dichloromethane, and dichlorobenzene). The 6 aromatics and 7 of the halogentaed organics were routinely observed. In one case exposure was related to drinking water from municipal wells contaminated by volatile organics including trichloroethane and trichloroethylene at the parts per million level. The results demonstrate that a difinitive description of volatile organics body burden is possible and that cases of elevated blood volatile organics may be identified and traced to possible environmental sources. (Rochester-PTT)
W86-05478

EVALUATION OF METABOLIC RESPONSES OF ARTEMIA SALINA TO OIL AND OIL DISPERSANT AS A POTENTIAL INDICATOR OF TOXICANT STRESS,

Athens Univ. (Greece). Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W86-05484

NONACCUMULATION OF CHLORINATED DIOXINS AND FURANS BY GOLDFISH EXPOSED TO CONTAMINATED SEDIMENT AND FLYASH,

New York State Office of Public Health, Albany. Wadsworth Center for Labs. and Research.
For primary bibliographic entry see Field 5B.
W86-05485

EARLY LIFE-STAGE TOXICITY TEST METHODS FOR GULF TOADFISH (OPSANUS BETA) AND RESULTS USING CHLORPYRIFOS,

D. J. Hansen, L. R. Goodman, G. M. Cripe, and S. F. Macauley.
Ecotoxicology and Environment Safety, Vol. 11, No. 1, p 15-22, February 1986. 2 tab, 33 ref.

Descriptors: *Water pollution effects, *Pesticides, *Gulf toadfish, *Toxicity, *Bioassays, *Chlorpyrifos, *Life-stage tests, Embryos, Fry, Juveniles, Mortality, Growth, Survival, Opsanus beta, Insecticides, Bioaccumulation.

Gulf toadfish were continuously exposed as embryos, sac fry, and juveniles to technical chlorpyrifos in two 49-day early life-stage toxicity tests. Survival was significantly (alfa = 0.05) reduced only in 150 micro g/L. However, toadfish exposed to chlorpyrifos concentrations of 3.7 - 150 micro g/L weighed significantly less than control fish: 9% lower in 3.7 micro g/L to 62% lower in 150 micro g/L. The 96-hr median lethal concentrations for juvenile fish was 520 micr g/L. Concentrations of chlorpyrifos in toadfish and bioconcentration factors increased with increasing exposure concentration, a condition generally observed with other marine fishes and other test chemicals. These results demonstrate the procedures for, and the practicality of, early life-stage tests with this marine species. The use of the gulf taodfish is recommended for comparative toxicity testing and for evaluating the toxicity of substances in conjunction with ontogenetical, physiological, and histological investigations of this considerably studied genus. The species is not recommended for routine effects testing. (Author's Abstract)
W86-05490

IN VITRO CYTOTOXICITY TESTING OF AQUATIC POLLUTANTS (CADMIUM, COPPER, ZINC, NICKEL) USING ESTABLISHED FISH CELL LINES,

Rockefeller Univ., New York. Lab. Animal Research Center.
H. Babich, C. Shopsis, and E. Borenfreund.
Ecotoxicology and Environmental Safety ECOLAR, Vol. 11, No. 1, p 91-99, February 1986. 7 fig, 1 tab, 24 ref.

Descriptors: *Toxicity, *Water pollution effects, *Toxic wastes, *Bioassay, *Cadmium, *Copper, *Nickel, *Zinc, *Bioindicators, Bluegill fry cells, Rainbow trout gonad cells, In vitro studies, Heavy metals, Neutral red assay, Population growth, Tritiated uridine uptake, Isotope studies, Protein analysis, Colony formation, Temperature, Pollutant identification.

The cytotoxicity of Cd toward cultured bluegill fry (BF-2) cells was determined using several assay endpoints. The concentrations of cadmium causing a 50% decrease in colony formation, cell replication, uptake of neutral red, population growth (as determined by protein analysis), uptake of (3H)uridine, and 50% detachment of cells (as determined by protein analysis) were 0.03, 0.04, 0.08, 0.09, 0.12, and 0.21 mM Cd, respectively. The neutral red assay was used to compare the relative sensitivities of BF-2 cells and rainbow trout gonad (RTG-2) cells toward four metals. The concentrations of Cd, Zn, Cu, and Ni causing a 50% reduction in the uptake of neutral red were 0.08, 0.19, 0.55, and 2.0 mM, respectively with the BF-2 cells and 0.18, 0.64, 1.45, and >>10.0mM, respectively with the RTG-2 cells. The RTG-2 cells were less sensitive to the metals, in particular to Ni. The less stringent temperature requirements for growth, their greater sensitivity to pollutants, and their markedly shorter doubling time in vitro make the BF-2 cells the preferable cell line for ecotoxicity screening of aquatic pollutants. (Author's abstract)
W86-05494

IMPORTANCE OF REDUCING SAMPLE CONTAMINATION IN ROUTINE MONITORING OF TRACE METALS IN ATMOSPHERIC PRECIPITATION,

Stockholm Univ. (Sweden). Meteorologiska Institutionen.
H. B. Ross.
Atmospheric Environment ATENBP, Vol. 20, No. 2, p 401-405, February 1986. 3 fig, 3 tab, 15 ref. Swedish Natural Science Research Council Contract G-GU 3922-111.

Descriptors: *Cadmium, *Copper, *Zinc, *Sweden, *Precipitation, *Trace Metals, Monitoring, Laboratory analyses, Errors, Scandanavia, Sample contamination.

At four sites in Sweden, atmospheric precipitation for trace metal analysis was collected simultaneously in acid-washed collectors and collectors only rinsed in water. The results indicate that samples could be greatly contaminated if the collectors and storage bottles were not acid washed. Risk of contamination was greatest for Cd, Cu, and Zn. In some instances Cu concentrations were a factor of 50 larger in samples that were collected and stored in bottles that were not acid washed. The concentrations found in atmospheric precipitation, collected, and stored in acid-washed equipment, are substantially lower than previously reported values for Scandanavia. It is concluded that many of the trace metal concentrations in atmospheric precipitation reported in the literature may be in error because proper precautions were not taken to avoid sample contamination. (Author's Abstract)
W86-05498

APPLICATIONS OF VOLTAMMETRY IN ENVIRONMENTAL SCIENCE,

Trinity Coll., Dublin (Ireland). School of Botany.
D. H. S. Richardson.
Environmental Pollution (Series B) EPSPDH, 10, No. 4, p 261-276, 1985. 7 fig, 3 tab, 54 ref.

Descriptors: *Pollutant identification, *Voltammetry, *Trace metals, Computers, Seawater, Freshwater, Alkali metals, Polarography, *Chemical analysis, Measuring instruments, Acidic water, Industrial wastes, Water analysis.

The wide-ranging applications of voltammetry to the analysis of trace metals and other ions of interest to environmental scientists, are reviewed for water, soil, animal tissue, plants, foods, and drugs. For environmental levels of trace elements in seawater, voltammetry has proved very suitable, as several metals can be determined simultaneously. Freshwater mediums provide fewer analytical problems than seawater, but the range of potential contaminants is very large. Metals from smelter operations or other industrial activities can be determined at extremely low levels. The possibility of determining levels of alkali metals using modified normal pulse polarography in an electrolyte consisting of hydrochloric acid and tetramethylammonium bromide is an important advance and should enable monitoring of alkali metals in acid streams. It is concluded that the availability of modern microprocessor controlled instrumentation, capable of performing both anodic stripping and square wave voltammetry, provides a flexible and powerful technique to aid in solving analytical problems, and carrying out routine analyses. (Main-PTT)
W86-05529

ACUTE TOXICITY OF PENTACHLOROPHENOL TO THE FRESHWATER SNAIL, GILLIA ALTILIS,

Boston Univ., MA.
For primary bibliographic entry see Field 5C.
W86-05534

SIMULTANEOUS MULTI-INSTRUMENTAL MONITORING OF VAPORS IN SEWER HEADSPACES BY SEVERAL DIRECT-READING INSTRUMENTS,

Cincinnati Univ. Medical Center, OH. Inst. of Environmental Health.
J. B. Barsky, S. S. Que Hee, C. S. Clark, and J. H. Trapp.
Environmental Research ENVRAL, Vol. 39, No. 2, p 307-320, April 1986. 8 fig, 4 tab, 8 ref. USPHS ES-00159.

Descriptors: *Sewer headspaces, *Condensable organic vapors, *Sewer gas, *Monitoring, *Hazard detection, *Saturated aliphatic organics, Cincinnati, Gas chromatography, Mass spectrometry, Flame ionization detector, Photoionization detector, Hydrogen sulfide ecolyzer, Ohio, Wastewater treatment facilities, Chemical plants.

Simultaneous monitoring of the vapors in several sewer headspaces by three direct-reading instruments, the Century OVA flame ionization detector, a 10.2 eV H-Nu photoionization detector, and a Hydrogen Sulfide Ecolyzer, revealed that the majority of condensable organic vapors in areas of the of the Metropolitan Sewer District of Cincinnati (Ohio) appeared to be saturated aliphatic organics, except during short, unpredictable episodes. The monitoring was performed in the wet well of a sewage treatment plant, in sewers near two chemical plants, and in three other different sewers. The approach outlined here does not require the use of gas chromatography mass spectrometry analysis. (Author's abstract)
W86-05572

SEPARATION AND DETERMINATION OF TRACES OF HEAVY METALS COMPLEXED WITH HUMIC SUBSTANCES IN FRESH WATERS BY SORPTION ON DIETHYLAMINOETHYL-SEPHADEX A-25,

Nagoya Univ. (Japan). Dept. of Engineering.
M. Hiraide, S. P. Tillekeratne, K. Otsuka, and A. Mizuike.
Analytica Chimica Acta ACACAM, Vol. 172, p 215-221, June 1985. 2 fig, 4 tab, 7 ref.

Descriptors: *Humic substances, *Humic acids, *Fulvic acids, *Heavy metals, *Lead, *Cadmium, *Copper, *Graphite-furnace atomic absorption spectrometry, Water analysis, Sephadex A-25.

Negatively-charged humic substances in a 1-liter water sample were selectively and quantitatively sorbed on a small column of the macroreticular weak-base anion exchanger, diethylaminoethyl-Sephadex A-25 (cross-linked dextran gel with diethylaminoethyl groups) and the heavy metals complexed with the humic substances were quantitatively desorbed with a small volume of 4 M nitric acid for graphite-furnace atomic absorption spectrometry. Copper (II), lead, and cadmium complexed in humic and fulvic acids were sorbed in this apparatus, but simple metal cations were not sorbed at all. For synthetic aqueous solutions containing traces of heavy metals and humic acid, the results conform with those obtained by cation-exchange separation. The method proposed here is simple and rapid in procedure and gives reproducible and reliable results. (Rochester-PTT)
W86-05574

DISSOLVED ZINC IN RIVERS,

Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
A. M. Shiller, and E. Boyle.
Nature NATUAS, Vol. 317, No. 6032, p 49-52, September 5, 1985. 2 fig, 2 tab, 14 ref. NSF Grant OCE 81-17929, Postdoctoral Fellowship.

Descriptors: *Zinc, *Rivers, Heavy metals, Trace metals, Chemical analysis, Spectrometers, Chemical precipitation, Water pollution sources.

Reliable measurements of the concentrations of dissolved trace metals in rivers are needed for calculating oceanic chemical mass balances, understanding continental weathering and freshwater chemistry, and evaluating anthropogenic chemical perturbations. It has been suggested that the typical river concentrations for dissolved zinc are as high as 450 nanomoles/kg+. There is a controversy associated with these values. Since zinc is a useful metal in the industrial world, the sampling and analysis of this element in natural waters is prone to contamination. Three samples were collected and analyzed with atomic absorption spectrometry following preconcentration with the cobalt-pyrrolidine dithiocarbamate method, with coprecipitation carried out at pH 4.5. Samples with high zinc concentrations (>15 nanomols/kg) were determined directly. The data indicate that in relatively undisturbed systems, dissolved zinc concentrations are typically only 10 to the 9th - 10 to the 8th mol/kg, with some dependence of concentration on pH. In industrially influenced river systems, zinc concentrations can be 1-2 orders of magnitude higher. (Khumbatta-PTT)
W86-05598

OXYGEN ISOTOPE RATIOS IN N2O FROM NITRIFICATION AT A WASTEWATER TREATMENT FACILITY,

New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
For primary bibliographic entry see Field 5D.
W86-05600

DETECTION AND ASSESSMENT OF GROUNDWATER CONTAMINATIONS BY ORGANIC CHEMICALS,

Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
P. Friesel, M. Kiper, G. Milde, D. Mulhausen, and V. Neumayr.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1043-1053, 1 fig, 4 tab.

Descriptors: *Groundwater pollution, *Organic compounds, *Chemical analysis, *Pollutant identification, *Risk assessments, Gas chromatography, Mass spectrometry, West Germany, Drinking water, Environmental effects.

The drinking water supply in West Germany is mainly based on natural groundwater resources (69%). This fact asks for comprehensive groundwater protection and quality control measures. The German drinking water regulations guarantee drinking water quality in total. Thus, sanitary requirements concerning all microbiological and chemical matters are guaranteed. For a number of substances (As, Pb, Cd, Cr, Hg, Se, Zn, CN(-), F(-), NO3(-), SO4(–) and polycyclic aromatic hydrocarbons), maximum concentrations are fixed and their identification is included in the standard quality examination. Using gas chromatography and mass spectrometry analysis of groundwater, differently exposed to environmental impacts, data showed that several chemicals seem to occur in up to a few micrograms/l in most instances. A source of specific contamination can only be identified when contents exceed ubiquitous values. Some solvents and fuel components seem to be ubiquitous in concentrations >nanograms/l. Risk assessment in case of low level groundwater contaminations still is a problem. Because as a rule no reliable toxicological evaluation is available, other standards have to be applied. As shown, a general 'zero level' for several chemicals cannot be used in practice, so background values are one possible yardstick. (See also W86-05679) (Lantz-PTT)
W86-05720

KERR RESERVOIR LANDSAT EXPERIMENT ANALYSIS FOR MARCH L98L,

Kentron International, Inc., Hampton, VA. Technical Center.
S. R. LeCroy.
Available from the National Technical Information Service, Springfield, VA. 22161, as N83-17922, Price codes: A04 in paper copy, A01 in microfiche. NASA Contractor Report 165959, July 1982. 48 p, 24 fig, 13 tab, 8 ref. Contract No. NAS1-16000.

Descriptors: *Kerr Reservoir, *Remote sensing, *LANDSAT, Water quality standards, Water quality, Virginia, North Carolina, Satellite technology, Algorithms, Suspended solids, Iron, Turbidity, Secchi disks, Nitrite, Tannin, Lignin.

An experiment was conducted on the waters of Kerr Reservoir to determine if reliable algorithms could be developed that relate water quality parameters to remotely sensed data. LANDSAT radiance data was used in the analysis since it is readily available and covers the area of interest on a regular basis. By properly designing the experiment, many of the unwanted variations due to atmosphere, solar, and hydraulic changes were minimized. The algorithms developed were constrained to satisfy rigorous statistical criteria before they could be considered dependable in predicting water quality parameters. A mix of different types of algorithms using the LANDSAT bands was generated to provide a thorough understanding of the relationships among the data involved. Except for secchi depth, the study demonstrated that for the ranges measured, the algorithms that satisfactorily represented the data encompass a mix of linear and nonlinear forms using only one LANDSAT hand. Ratioing techniques did not improve the results since the initial design of the experiment minimized the errors against which this procedure is effective. Good correlations were found for total suspended solids, iron, turbidity, and secchi depth. Marginal correlations were discovered for nitrate and tannin and lignin. Quantification maps of Kerr Reservoir are presented for many of the water quality parameters using the developed algorithms. (Author's abstract)
W86-05746

CORRELATION OF CHLOROPHYLL CONCENTRATIONS AND SUSPENDED SOLIDS WITH NEAR-SURFACE UPWARD IRRADIANCE WITHIN LANDSAT BANDS 4, 5 AND 6,

Institute of Physical and Chemical Research, Saitama (Japan).
S. Sugihara, M. Kishino, and N. Okami.
Journal of the Oceanographical Society of Japan, Vol. 41, No. 2, p 81-88, April 1985. 6 fig, 17 ref.

Descriptors: *Remote Sensing, *Seawater, *Chlorophylla, *Suspended Load, Irradiance, Landsat, Pollution, Suspended solids, Satellite technology.

Near-surface upward irradiances within each band of MSS (multi spectral scanner) of Landsat, were computed from observed spectral upward irradiances measured beneath the sea surface. Computation of these irradiances is a useful first step in the analysis of remotely-sensed radiance because the data are not affected by the effects of the atmosphere and sea surface. The computed irradiance E in Landsat bands 4, 5 and 6 was normalized by forming ratios, and then the relationship between these ratios and chlorophyll a plus phaeopigment concentration (C) observed simultaneously at 59 stations was examined by linear regression analysis. The observed C ranged over nearly three orders of magnitude, and there is a close to linear relationship between logR to the base 45 (one of the ratios) and log C. This suggests that it may be possible to evaluate C from Landsat data, if an appropriate atmospheric correction is made. The relationship between suspended solids determined at 35 stations and the same ratios of upward irradiance is also presented and discussed. (Master-PTT)
W86-05813

REGENERATION OF CHEMICAL ELEMENTS FROM SETTLING PARTICLES COLLECTED BY SEDIMENT TRAP IN FUNKA BAY, JAPAN,

Hokkaido Univ., Sapporo (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-05814

INVESTIGATIONS ON BORON DETERMINATION IN SURFACE WATERS BY AZOMETHINE H,

Rostock Univ. (German D.R.). Inst. fuer Allgemeine und Kommunale Hygiene.
F. F. E. Randow.
Zeitschrift fuer Wasser -und Abwasserforschung ZWABAQ, Vol. 18, No. 4, p 190-193, August 1985. 1 fig, 3 tab, 26 ref.

Descriptors: *Boron, *Water analysis, *Chemical analysis, *Colorimetry, Surface water, Azomethine H, Color.

The colorimetric determination of borate in water by azomethine H (procedure DIN 38405- D 17) has been defined exactly for natural waters by detailed investigations of natural samples (rivers and lakes) and synthetic samples (humic acid solution with boron standard added). Measurements of the light influence on color development showed that light protection is not necessary. The boron-azomethine H complex formation was examined with respect to temperature and time. In the range 12-24 degrees the absorbance maximum is already reached after 1 hr and stayed constant for at least 1 hr. Tests of the interference of the sample color indicated a direct proportionality between color and color correction to be considered and the overestimated boron respectively. The recoveries of natural and synthetic samples were 86-104%. The standard deviation of the procedure in the working range 20-200 microgram/l boron was 3 microgram/l and the detection limit 16 microgram/l; P=99%, n=8. (Master-PTT)
W86-05822

EFFECTS OF ATRAZINE AND 2,4-DICHLOROPHENOXYACETIC ACID TO THE POPULATION DENSITY OF PHYTO- AND ZOOPLANKTON IN AN AQUATIC OUTDOOR SYSTEM,

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
For primary bibliographic entry see Field 5C.
W86-05825

CHARACTERISTICS OF DYSGONIC, HETEROTROPHIC BACTERIA FROM DRINKING WATER,

Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
D. F. Spino.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 5, p 1213-1218, November 1985. 2 fig, 6 tab, 12 ref.

Descriptors: *Bacteria, *Water distribution, *Drinking water, *Heterotrophic bacteria, *Bioindicators, Culture media.

The heterotrophic plate count has been used as an indicator of the effectiveness of water treatment and of the microbial quality of drinking water. The purpose of this study was to biochemically characterize representative, nonclassifiable, heterotrophic gram negative bacteria. However, it is difficult to get heterotrophic bacteria to grow on conventional media. Organisms were isolated on standard plate count agar (SPCA), then subcultured to R3A medium. These cultures were then inoculated to a modified O/F base medium with a lower incubation temperature (30 C). The results emphasize the variety of metabolic types of heterotrophic bacteria in drinking water. Identification of the organisms is very tedious and any potential risk posed by their presence is at this time unknown. (Adams-PTT)
W86-05827

CRITICAL APPRAISAL OF THE COLIFORM TEST,

Severn-Trent Water Authority (England).
W. M. Waite.
Institution of Water Engineers and Scientists Journal JIWSDI, Vol. 39, No. 4, p 341-357, August 1985. 5 tab, 55 ref.

Descriptors: *Coliforms, *Escherichia coli, *Water pollution, *Pollutant identification, Fecal pollution, Water quality standards, Modified thermotolerant coliforms, Bioindicators.

The use of the total coliform group has been used by water bacteriologists as a test for fecal pollution for some time. Escherichia coli has been used as a supplemental indicator. New technologies and methods exist, but some water bacteriologists are cautious. Other applications advocated to detect water pollution are the use of modified thermotolerant coliforms, e.g., aeromonads, to indicate fecal pollution and total mesophilic enteroforms (TME) and/or negative mesophilic enteroforms (OME) to monitor groundwater quality. For treated water entering the supply system, it is suggested that the TME group be used as a bioindicator and for water in the distribution system the use of TME, OME and modified thermotolerant coliforms is advocated. (Adams-PTT)
W86-05839

226RA AND 228RA IN WATER SUPPLIES,

Argonne National Lab., IL. Radiological and Environmental Research Div.
H. F. Lucas.
American Water Works Association Journal

JAWWA5, Vol. 77, No. 9, p 57-67, September 1985. 1 fig, 5 tab, 33 ref.

Descriptors: *Radium radioisotopes, *Water quality, *Water pollution, Radioisotopes, Well water.

A method for predicting the concentration of radium in well waters is based on the well's location, the details of its construction, and the geological structures it penetrates. However, as in Aurora, Ill., 226Ra concentrations ranging from 3.8 to 18 pCi/L were found for wells of nearly identical construction located within relatively short distances from each other. Even larger deviations were found for comparisons among cities. The 228Ra concentration was determined in 140 of these samples and ranged from 0.3 to 32 pCi/L. Data obtained by other investigators in Iowa put the median 228Ra to 226Ra ratio at 0.64. Regression analysis, however, does not suggest any meaningful correlation of 228Ra and 226Ra. Because high concentrations of 228Ra have been found in areas with low 226Ra concentrations and 228Ra is not detected by gross-alpha analysis, it appears that a large-scale survey of 228Ra in water is needed. (Author's Abstract)
W86-05869

COMMITTEE REPORT: CURRENT PRACTICE IN BACTERIOLOGICAL SAMPLING.

American Water Works Association, New York.
For primary bibliographic entry see Field 5F.
W86-05871

IDENTIFICATION OF HYDROXYMETHANESULFONATE IN FOG WATER,

California Inst. of Tech., Pasadena. W.M. Keck Lab. of Environmental Engineering Science.
J. W. Munger, C. Tiller, and M. R. Hoffmann.
Science SCIEAS, Vol. 231, No. 4735, p 247-249, January 17, 1986. 2 fig, 1 tab, 20 ref.

Descriptors: *Fog, *Chemistry of precipitation, *Acid rain, *Sulfonates, Organic compounds, Sulfur, Formaldehyde, Sulfur dioxide.

Previous studies have suggested that hydroxymethanesulfonate ion (HMSA) can be an important species in fog and cloud water. Formation of HMSA explains observed excesses of sulfur in the S(IV) state and formaldehyde in fogs and clouds. HMSA was determined in fog water by a novel ion-pairing chromatographic technique. Concentrations in samples collected in Bakersfield, California, within 5 km of major sources of sulfur dioxide (SO2), were as high as 300 micromoles/l. Total CH2O and S(IV) concentrations, which were measured independently, ranged from 10 to 200 and 5 to >300 micromoles per liter, respectively. Concentrations of CH2O, S(IV), and HMSA at Buttonwillow, California, which is 15 km from the nearest source of SO2, were less than those at Bakersfield but not absent. These data confirm that HMSA forms in atmospheric water droplets and can reach appreciable concentrations. HMSA represents an important source of acidity for water droplets and may also play a role in long-distance transport and transformation of SO2. (Author's Abstract)
W86-05873

STABILITY OF TURBIDITY IN RAW WATER AND ITS RELATIONSHIP TO CHLORINE DEMAND,

Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
For primary bibliographic entry see Field 5F.
W86-05886

EFFECT OF ATMOSPHERIC POLLUTION ON THE OUTFLOW AND ACCUMULATION OF HEAVY METALS IN THE DRAINAGE BASINS OF THE NIEPOLOMICE FOREST (SOUTHERN POLAND),

Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
For primary bibliographic entry see Field 5B.
W86-05889

TAXONOMY OF SYNURA (CHRYSOPHYCEAE) IN ONTARIO WITH SPECIAL REFERENCE TO TASTE AND ODOR IN WATER SUPPLIES,

Ontario Ministry of the Environment, Rexdale. Water Resources Branch.
K. H. Nicholls, and J. F. Gerrath.
Canadian Journal of Botany CJBOAW, Vol. 63, No. 8, p 1482-1493, August 1985. 26 fig, 3 tab, 69 ref.

Descriptors: *Algae, *Chrysophyta, *Synura, *Taste, *Odors, *Plankton, *Odor-producing algae, Taxonomy, Ontario, Lakes, Species composition, Algae, Organoleptic properties, Ponds, Algae.

Electron microscopy of silica scales was used to identify 13 taxa of the colonial chrysophyte Synura found in Ontario lakes and ponds. One of the taxa has not been reported previously from North America (Synura spinosa f. longispina Petersen & Hansen). Two others found in Ontario (Synura splendida Korshikov and Synura petersenii f. praefracta Asmund) have previously been reported only once from North America. One new combination is proposed (Synura leptorrhabda (Asmund) Nicholls) which provides for more consistent taxonomy of species in the Synura echinulata group (S. echinulata Korshikov, Synura mammillosa Takahashi, Synura multidentata (Balonov & Kuzmin) Peterfi & Momeu, and S. leptorrhabda). The systematics of other problematic taxa, including the related genus Chrysodidymus, are discussed. Samples containing Synura spp., previously implicated in 11 recent cases of 'fishy' taste and odor in Ontario lakes, were reexamined by electron microscopy and found to be dominated by S. petersenii Korshikov. All affected sites were lakes of the Precambrian Shield (pH 5.7-7.5; alkalinity <1-45 mg CaCO3/L). No evidence has been found of obnoxious tastes or odors from other Synura species. (Doria-PTT)
W86-05936

SIMPLEX OPTIMIZATION OF EXTRACTIVE ALKYLATION PROCEDURES FOR ORGANIC ACIDS IN AQUEOUS SAMPLES,

State Univ. of New York at Buffalo. Dept. of Chemistry.
M. K. L. Bicking, and N. A. Adinolfe.
Journal of Chromatographic Science JCHSBZ, Vol. 23, No. 8, p 348-351, August 1985. 2 fig, 2 tab, 11 ref. NIH grant BRSG SO 7RR07066.

Descriptors: *Simplex optimization procedures, *Extractive alkylation, *Organic acids, *Pollutant identification, Quantitative analysis, Drinking water, Adipic acid, Carboxylic acid, Phenols, Hydrogen ion concentration, Methylation, Mathematical studies.

The determination of organic acids in drinking water is an important analytical problem. Simplex optimization procedures may be used to optimize the yield from an extractive alkylation procedure. Three variables from the derivatization reaction (pH, methylating agent concentration, and phase transfer agent concentration) were chosen for optimization because they interacted with each other and could not be optimized by conventional means. The yield for methylation of adipic acid was doubled with relatively little effort. This procedure may be easily applied to other systems. (Doria-PTT)
W86-05944

GAS CHROMATOGRAPHIC MICROMETHOD FOR TRACE DETERMINATIONS OF PHENOLS,

Oklahoma Univ., Norman. Environmental and Ground Water Inst.
G. Bengtsson.
Journal of Chromatographic Science JCHSBZ, Vol. 23, No. 9, p 397-401, September 1985. 2 fig, 4 tab, 19 ref. EPA Assistance Agreement CR 806931.

Descriptors: *Pollutant identification, *Gas chromatography, *Phenols, *Trace levels, Detection limits, Quantitative analysis, Electron capture.

A gas chromatographic procedure is described for the analysis of a variety of substituted phenols from water samples. The method was designed for samples of limited size (0.5 to 1.0 ml), such as in laboratory microcosm experiments on transport and fate of pollutants. The phenols were extracted, derivatized, and quantified by flame ionization and electron capture detection. Toluene gave a better extraction efficiency than acetone, hexane, dichloromethane, and ethylacetate, yielding essentially the same recovery from spiked well water samples as direct acetylation with acetic anhydride. Between 5 and 35 ng/ml of different phenols were detected. The heptafluorobutyryl derivatives possessed high electron capture sensitivity, ranging from 0.1 to 7.6 pg of individual phenols. The practical detection limit for phenol, chlorophenols, p-cresol, dimethyl-, and nitrophenols was from 0.01 to 0.20 ng/ml, with one exception, 2,4-dinitrophenol, which had low extractability and electron capture sensitivity, resulting in a detection limit of 1.6 ng/ml. (Doria-PTT)
W86-05945

DETERMINATION OF ANIONS IN COOLING TOWER WASTEWATER FROM COAL GASIFICATION BY ION CHROMATOGRAPHY,

North Dakota Univ., Grand Forks. Energy Research Center.
M. E. Potts, and T. A. Potas.
Journal of Chromatographic Science JCHSBZ, Vol. 23, No. 9, p 411-414, September 1985. 2 tab, 10 ref.

Descriptors: *Pollutant identification, *Ion chromatography, *Anions, *Cooling towers, *Industrial wastewater, *Coal gasification, Chromatography, Monitoring, Chlorides, Nitrates, Nitrites, Phosphates, Sulfates, Thiocyanates, Thiosulfates, Qualitative analysis, Chemical analysis.

Chemically suppressed ion chromatography was used to monitor inorganic anions in cooling tower wastewater from coal gasification. Results were compared to the determination of anions by classical wet chemical methods. Ion chromatography proved to be an effective method in the analysis of chloride, nitrate, nitrite, phosphate, sulfate, thiocyanate, and thiosulfate in the complex matrix of cooling tower wastewater from coal gasification. Ion chromatography allows the simultaneous determination of several anion concentrations in a matter of minutes vs. hours with ordinary wet chemical methods. (Doria-PTT)
W86-05946

ANALYSIS OF EXPLOSIVES IN WATER BY CAPILLARY GAS CHROMATOGRAPHY,

Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD.
F. Belkin, R. W. Bishop, and M. V. Sheely.
Journal of Chromatographic Science JCHSBZ, Vol. 23, No. 12, p 532-534, December 1985. 2 fig, 2 tab, 8 ref.

Descriptors: *Pollutant identification, *Quantitative analysis, *Explosives, *Capillary gas chromatography, *Gas chromatography, Chromatography, Monitoring, Dinitrotoluenes, Trinitrotoluenes, Chemical analysis, Toluene.

A method has been developed for the quantitative analysis of water for low ppb levels of several explosive-type compounds. These include 2,4,6-trinitrotoluene; tetryl; 2,4-dinitrotoluene (2,4-DNT); and 2,6-DNT. The compounds are extracted from water with toluene and analyzed by capillary column gas chromatography with electron capture detection. Accuracy and precision of the method were studied in water spiked at the 1-, 10-, and 100-ppb levels; average recoveries ranged between 96 and 103%. This method saves time and gives better recovery for dinitrotoluene analysis than EPA Method 625. A stability study of the compounds in water at pHs between 0.5 and 10 was performed over a 33-day period. Significant losses occurred in water at >pH 6, with tetryl's being the most affected, and the dinitrotoluenes the least. The method also can be applied to the explosive RDX for qualitative purposes, but it is not suitable for

quantitation due to poor extraction efficiency of RDX into toluene. (Doria-PTT)
W86-05947

FIELD AND LABORATORY MEASUREMENT OF PH IN LOW-CONDUCTIVITY NATURAL WATERS,

Institute of Hydrology, Wallingford (England).
C. Neal, and A. G. Thomas.
Journal of Hydrology JHYDA7, Vol. 79, No. 3/4, p 319-322, July 1985, 13 ref.

Descriptors: *Electrodes, *Acid raid, *Water analysis, *Conductivity, *Hydrogen ion concentration, Field measurements, Rainfall, Precipitation, Acidity, Measuring instruments.

Most field and laboratory pH measurement involves silver-silver chloride and calomel cells. Although inexpensive, convenient and portable these devices are not sufficiently accurate for low-conductivity waters such as rainfall and many upland streams. Sources of error include the major differences that are obtained using different electrodes; unstable readings caused by variations in the electrode used and its storage history; differences in pH readings caused by differences in temperature between sample, buffer and electrode; and stirring of the sample during measurement. Suggested solutions include the introduction of new electrodes which avoid the liquid function potential problem; new, more representative calibration solutions; the addition of an inert electrolyte to increase the conductivity of the samples which reduces the stirring effect; the use of isothermal conditions during measurement. The standard approach to acceptance of an electrode should be changed to include measurements of dilute mineral acids of known pH, which should be incorporated into the manufacturer's electrode specification. (McFarlane-PTT)
W86-05988

PREPARATION OF WATER SOLUBLE FRACTIONS OF CRUDE OILS FOR TOXICITY STUDIES,

Canberra Coll. of Advanced Education, Belconnen (Australia). Water Research Centre.
W. A. Maher.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 2, p 226-229, February 1986, 1 fig, 1 tab, 9 ref.

Descriptors: *Oil, *Petroleum, *Toxicity, *Testing procedures, *Water soluble fraction, Hydrocarbons, Laboratory methods, Chemical analysis.

The factors affecting the preparation of water soluble fractions of oils by the slow stirring method and after filtration through membranes of varying pore sizes were examined to establish the importance of particulate matter in the process of solubilization. The aromatic hydrocarbon concentrations of the aqueous phases gradually increased over 24-48 hours after which a decrease in concentration occurred. Losses were attributed to the loss of particulate oil from solution as the aromatic hydrocarbon concentrations of filtered solutions remained constant. Increasing the amount of oil added did not increase the water soluble aromatic hydrocarbon concentrations in direct proportion. The aromatic hydrocarbon concentrations of water soluble extracts were progressively decreased by filtration through membranes of smaller pore size, illustrating the contribution of particular matter. Mixing time, oil-water ratio, and the particulate oil solubilized need to be controlled to obtained reproducible and comparable water soluble fractions of crude oils for toxicity studies. (McFarlane-PTT)
W86-05998

SOIL ALGAE IN POLLUTED SOILS,

Kirovskii Selskokhozyaistvennyi Inst. (USSR).
For primary bibliographic entry see Field 5C.
W86-06010

USE OF PROTOZOAN COMMUNITIES TO PREDICT ENVIRONMENTAL EFFECTS OF POLLUTANTS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5C.
W86-06027

MICROTOX AND SPIRILLUM VOLUTANS TESTS FOR ASSESSING TOXICITY OF ENVIRONMENTAL SAMPLES,

Alberta Environmental Centre, Vegreville.
R. N. Coleman, and A. A. Qureshi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 35, No. 4, p 443-451, October 1985. 4 tab, 20 ref.

Descriptors: *Bioindicators, *Bioassay, *Bacteria, *Toxicity, Industrial wastes, Landfills, Leachates, Potable water, Mine drainage, Surface water.

As part of a program in assembling and establishing a battery of short-term bacterial toxicity tests, we examined the use of Microtox and S. volutans for determining the toxicity of a wide variety of environmental samples were examined. Several complex effluent samples were collected from industry sites, a sanitary landfill, potable and surface water, and a mine tailings pond. All the samples were aqueous and of unknown composition and were assayed by the two tests at their observed pH. With the exception of one sample, all potable and surface water samples were non-toxic. Similarly, only a few of the effluents were designated toxic by these tests. All four mine tailings pond water samples, however, were classified as toxic by at least on of the tests. There was a general similarity and good agreement between the response of Microtox and S. volutans tests. The data indicate that the Microtox was more sensitive than the S. volutans assay. Observations suggest that for comparative purposes a 30 min MEC 90 be adopted as a standard in the testing of natural samples by the S. volutans assay. The results of this study demonstrate that the Microtox and S. volutans tests are potentially useful for the detection of effluent or chemical toxicity. That there is no one universal test that can be used in all situations. In addition, one bioassay cannot provide results equivalent to that of another bioassay. It is suggested that a battery of short-term tests employing organisms from various trophic levels be used for assessing toxicity in aquatic environments. (Main-PTT)
W86-06067

DETERMINATION OF TRACE POLYMER IN WASTE WATER,

Neya River Basin - Wide Sewage Works Association, Osaka (Japan).
For primary bibliographic entry see Field 5D.
W86-06068

TOXICITY OF COAL GASIFIER SOLID WASTE TO THE AQUATIC PLANTS SELENASTRUM CAPRICORNUTUM AND SPIRODELA OLIGORHIZA,

Memphis State Univ., TN. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W86-06073

ANALYSIS OF DRINKING WATER FOR THE DETECTION OF TRIHALOMETHANES,

University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
N. M. Fayad, and S. Iqbal.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 5, p 576-582, November 1985. 1 fig, 3 tab, 10 ref.

Descriptors: *Drinking Water, *Trihalomethanes, *Saudi Arabia, *Chemical analysis, Liquid/Liquid Extraction, Gas Chromatography, Chlorination.

Chlorination is the only disinfection method applied to blended Dammam water before it is pumped into the distribution system. The extent of the occurrence of trihalomethanes (THMs) was determined in finished drinking water samples from several locations in most of the major cities in Eastern Province in Saudi Arabia. Liquid/liquid extraction preceded analysis by gas chromatography. The mean THM concentration in the distribution system of Dammam was 14.2 micro g/L. The mean values found in Khobar, Aramco, Dhahran and Jubail were 11.4, 7.5, 4.2, 6.4 micro g/L respectively. Water samples from the University of Petroleum and Minerals showed THM concentrations of 0.3 micro g/L. The absence of chlorine in this system could be the reason for the low THM concentrations found. The mean values obtained for THMs at the survey locations are generally low compared with the US EPA maximum allowable concentration. (Main-PTT)
W86-06075

STATISTICAL ANALYSIS OF HEAVY METAL CONCENTRATIONS FROM LAKE SEDIMENTS,

Texas A and M Univ., College Station. Center for Trace Characterization.
For primary bibliographic entry see Field 5B.
W86-06088

AUTOMATIC METHOD FOR ON-LINE ESTIMATION OF THE PHOTOSYNTHETIC RATE IN OPEN ALGAL PONDS,

Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Electrical and Computer Engineering.
For primary bibliographic entry see Field 2H.
W86-06104

OPTIMIZATION OF WATER QUALITY MONITORING NETWORKS,

Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7A.
W86-06118

METHODOLOGY FOR ESTIMATING NUMBERS OF FREE-LIVING AND ATTACHED BACTERIA IN ESTUARINE WATER,

Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 2L.
W86-06139

GEOCHEMICAL FACTORS COMPLICATING THE USE OF AUFWUCHS TO MONITOR BIOACCUMULATION OF ARSENIC, CADMIUM, CHROMIUM, COPPER AND ZINC,

Savannah River Ecology Lab., Aiken, SC.
For primary bibliographic entry see Field 5B.
W86-06157

HEPATITIS A VIRUS CONCENTRATION ON CELLULOSE MEMBRANES (CONCENTRATION DU VIRUS DE L'HEPATITE A SUR DES MEMBRANES DE CELLULOSE),

Lyon-1 Univ., Villeurbanne (France). Lab. de Microbiologie.
J. Passagot, J. M. Crance, R. Deloince, H. Laveran, and D. Beytout.
Water Research WATRAG 19, No. 9, p 1167-1170, 1985. 2 fig, 1 tab, 21 ref.

Descriptors: *Separation techniques, *Viruses, *Filtration, *Membrane filters, *Adsorption, Human diseases, Pollutant identification, Assays.

The filter adsorption-elution method was used to concentrate Hepatitis A Virus (HAV) from experimentally-contaminated distilled water. Filtration was performed through two cellulose membranes and eluate or filtrate viruses were precipitated by polyethylene glycol 6000. HAV is detected by solid phase radioimmunoassay. HAV adsorption at pH levels between 3 and 4 did not vary significantly. Beef extract proved a better eluent than 0.2 M glycin buffer for HAV elution. HAV adsorption is the most efficient at acid pH levels. Between pH 4.5 and 5, the remarkable adsorption decrease might be related to the inversion of the HAV electrostatic charge sign. It was suggested that from pH 7.5, both the HAV particles and membranes have negative charges which give enough repulsive forces to allow a good elution efficiency.

The improvement of HAV elution efficiency by beef extract might be explained by the proteinaceous material present in beef extract. HAV replication in cell cultures shows the biological properties are preserved after this procedure. (Geiger-PTT)
W86-06158

5B. Sources Of Pollution

RESPONSE OF THE MICROFLORA IN OUTDOOR EXPERIMENTAL STREAMS TO PENTACHLOROPHENOL: ENVIRONMENTAL FACTORS,

Minnesota Univ., Navarre. Gray Freshwater Biological Inst.
For primary bibliographic entry see Field 5C.
W86-05418

QUANTITATIVE CHARACTERIZATION OF MICROBIAL BIOMASS AND COMMUNITY STRUCTURE IN SUBSURFACE MATERIAL: A PROKARYOTIC CONSORTIUM RESPONSIVE TO ORGANIC CONTAMINATION,

Florida State Univ., Tallahassee. Dept. of Biological Science.
For primary bibliographic entry see Field 5A.
W86-05421

SOLUTIONS FOR RADIONUCLIDE TRANSPORT FROM AN INJECTION WELL INTO A SINGLE FRACTURE IN A POROUS FORMATION,

Wisconsin Univ.-Madison. Dept. of Civil and Environmental Engineering.
C. S. Chen.
Water Resources Research WRERAO, Vol. 22, No. 4, p 508-518, April, 1986. 10 fig, 21 ref.

Descriptors: *Path of Pollutants, *Solute transport, *Radioisotopes, *Fracture permeability, Porous media, Groundwater movement, Model studies, Mathematical models, Injection wells, Wells.

Radionuclide transport from an injection well to a fractured porous formation is studied using the Laplace transform technique. Two models are used. Model I assumes that radionuclides are transported through the fracture by radial advection and longitudinal dispersion, while model II assumes radial advection only. In both models attenuation mechanisms, such as radioactive decay and adsorption of linear equilibrium isotherms, are considered in the fracture and in the porous rock. Molecular diffusion accounts for transport from the fracture to the surrounding porous rock. Analytical solutions of concentration distributions valid for small-time periods and for steady state are obtained for model I; solutions at intermediate and large time intervals are determined by inverting the appropriate Laplace transform equation with the Stehfest method. Analytical solutions of concentration distributions for the transient and steady state conditions are given for model II. Computational results of both models converge at large injection time periods, indicating that the effect of longitudinial dispersion on the transport of radionuclides may be unimportant at long injection periods. (Cassar-PTT)
W86-05431

GROUNDWATER TRANSPORT OF STRONTIUM 90 IN A GLACIAL OUTWASH ENVIRONMENT,

Geological Survey, Denver, CO.
K. L. Kipp, Jr., K. G. Stollenwerk, and D. B. Grove.
Water Resources Research WRERAO, Vol. 22, No. 4, p 519-530, April, 1986. 4 fig, 5 tab, 22 ref.

Descriptors: *Path of pollutants, *Geochemistry, *Solute transport, *Radioisotopes, *Glacial sediments, Sediments, Strontium radioisotopes, Uranium, Groundwater movement, Model studies, Mathematical models, Wood River Junction, Pawcatuck River, Rhode Island, Ion exchange.

A model was developed to predict the transport of strontium-90 in glacial outwash sediments. Based on an approximate mechanism for ion exchange, the multicomponent system was simplified to two components by considering all exchangable cations other than strontium-90 as a single component. The binary, ion-exchange parameter was a function of the variable, total ion concentration. A one-dimensional solute transport model was formulated to evaluate the time necessary for natural groundwater flow to remove the strontium-90 pollutant plume from the groundwater system to the Pawcatuck River from the uranium-scrap recovery plant at Wood River Junction, Rhode Island. Clay-free quartz and feldspar sands at the study site have little potential for strontium-90 sorption. As the total ion concentration plume moves out of the system, ion exchange of strontium-90 increases, reducing its concentration in the groundwater. The model predicted that the contaminant level would be reduced to drinking water standards in about a decade. The cleanout times using the binary ion exchange mechanism were about two-thirds of those predicted using a constant distribution coefficient. (Cassar-PTT)
W86-05432

RADIONUCLIDE MIGRATION IN STRONGLY FISSURED ZONES: THE SENSITIVITY TO SOME ASSUMPTIONS AND PARAMETERS,

Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
A. Rasmuson, and I. Neretnieks.
Water resource Research WRERAO, Vol. 22, No. 4, p 559-569, April, 1986. 15 fig, 7 tab, 22 ref.

Descriptors: *Path of pollutants, *Groundwater movement, *Fate of pollutants, *Radioactive wastes, *Geological fissures, Hydrology, Geologic fractures, Model studies, PSEUDOBODY model, Wastes.

Radionuclides escaping from a repository for high-level nuclear waste in crystalline rock may eventually be carried by the flowing water in fissure zones. In such zones the rock is broken down into blocks of varying sizes and shapes and the water velocity may vary considerably. A previously developed model which lumps the different blocks into a single PSEUDOBODY was tested by comparing it with an exact analytical solution which can account for the diffusion into blocks of any size distribution. The approximate simplified model, which is based on a numerical scheme, and thus is more versatile, gives errors which are small compared to the normal variation in observed block size distributions and other data. A method for determining an average Peclet number (or dispersion length) in a strongly varying velocity field was tested and have small errors compared to the present confidence limits in predicting dispersion data for large migration distances. A simple criterion is proposed for defining the cutoff limit in the block size distribution, below which the blocks can be modeled as if they were in equilibrium with the flowing water. A simple sensitivity analysis shows that much can be gained if the confidence limits or block size distribution, water flow rate, dispersion data, sorption data, and matrix diffusion data can be narrowed down. (Author's Abstract)
W86-05436

DIFFUSIVITY MEASUREMENTS AND ELECTRICAL RESISTIVITY MEASUREMENTS IN ROCK SAMPLES UNDER MECHANICAL STRESS,

Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
K. Skagius, and I. Neretnieks.
Water Resources Research WRERAO, Vol. 22, No. 4, p 570-580, April 1986. 19 fig, 4 tab.

Descriptors: *Path of pollutants, *Groundwater movement, *Fate of pollutants, *Groundwater, *Radioactive wastes, Stress, Resistivity, Wastes, Porous media, Diffusivity, Pressure.

If radionuclides are released from an underground repository and enter the groundwater, they would be transported with the moving groundwater in fissures in the rock. Besides fissures the rock also contains micropores filled with stagnant groundwater. If the nuclides diffuse into these micropores, a significant retardation of the nuclides can be expected. At repository depths, the rock is under high stresses caused by the large overburden of rock. In drill cores this overburden no longer exists and there might be an increase in the porosity of the rock samples. The effective diffusivity measured in rock samples under atmospheric pressure in the laboratory would then be higher than the effective diffusivity in the rock in situ. To simulate the stress that may exist in the bedrock at large depths, diffusion experiments with iodide and electrical resistivity measurements in rock materials under mechanical stress were performed. The diffusivity in rock samples at 300-350 bars stress was reduced to 20-70% of the value in the samples under atmospheric pressure. This reduction of the diffusivity in stressed rock is probably of minor importance because of the rather large variation in diffusivity between samples. (Cassar-PTT)
W86-05437

REGRESSION APPROXIMATIONS FOR TRANSPORT MODEL CONSTRAINT SETS IN COMBINED AQUIFER SIMULATION-OPTIMIZATION STUDIES,

Geological Survey, Denver, CO.
W. M. Alley.
Water Resources Research WRERAO, Vol. 22, No. 4, p 581-586, April 1986. 2 fig, 3 tab, 5 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Solute transport, *Groundwater pollution, Model studies, Mathematical models, Regression analysis, Wells.

The use of contaminant transport models with ordinary regression and regression on ranks was used to develop approximate response functions of concentrations at critical locations as a function of pumping and recharge at decision wells. The solutions obtained can be used to establish starting solutions for optimization formulations that include a transport model, or, in the case of limited computer or money resources, to obtain relatively efficient strategies. Two hypothetical cases involving steady state transport and one involving transient transport (the use of pumping to maintain concentrations from a migrating plume of tritium <20 n Ci/L at three supply wells) are considered. In these examples, there did not appear to be any advantage to the weighted regression approaches and ordinary regression generally performed better than rank regression. (Cassar-PTT)
W86-05438

OCCURRENCE OF VOLATILE ORGANIC CHEMICALS IN NEBRASKA GROUND WATER,

Hoskins-Western-Sonderegger, Inc., Lincoln, NE.
O. Goodenkauf, and J. C. Atkinson.
Ground Water GRWAAP, Vol. 24, No. 2, p 231-233, march-April, 1986. 4 tab, 4 ref.

Descriptors: *Fate of pollutants, *Organic compounds, *Volatile organic compounds, *Groundwater pollution, Wells, Water supply, Chlorinated hydrocarbons, Nebraska, Monitoring.

Monitoring programs for volatile synthetic organic chemicals in Nebraska's private and public water supply wells are summarized. Quantifiable levels volatile organics were found in 16.5% of the 97 community water supply systems, sampled as of June 1984; in 15.9% of the 63 private wells sampled in 1982. Of the 32 contaminated public supply wells, the concentrations of volatile organics (in micrograms/liter) were <5 in 13 wells, 5.0-9.9 in 6 wells, 10-49 in 6 wells, 50-99 in 3 wells, and >100 in 4 wells. Of the 10 contaminated private wells, the concentrations of volatile organics (in micrograms/liter) were <5 in 5 wells, 5.0-9.9 in 1 well, 10-49 in 2 wells, 50-99 in 1 well, and >100 in 1 well. (Cassar-PTT)
W86-05449

THREE-DIMENSIONAL CLOUD CHEMISTRY MODEL,

McGill Univ., Montreal (Quebec). Dept. of Meteorology.

A. Tremblay, and H. Leighton.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 25, No. 5, p 652-671, May 1986. 3 tab, 20 fig, 46 ref.

Descriptors: *Clouds, *Chemistry of precipitation, *Acid rain, *Convective precipitation, Continuity equations, Scavenging, Aqueous phases, Gaseous phases, Simulations, Mathematical model, Sulfate, Nitrate, Ammonia, Sulfur dioxide.

A cloud chemistry model is formulated in terms of continuity equations for chemical species in the aqueous and gaseous phases within the cloud. The model includes scavenging of SO2, HNO3, NH3, H2O2, and sulfate aerosol particles. Calculations have been performed within the framework of a three-dimensional convective cloud model. Simulations are discussed for a case where some measurements of the chemistry of the cloud water and ambient air are available, and comparisons between simulated and measured concentrations of some ions are presented. The results are compared with aircraft measurements of cloud water chemistry; in all cases the model underpredicts the concentrations of ionic species in the cloud water. (Peters-PTT)
W86-05463

BASIC ENCODED MODEL FOR FLOW-THROUGH FIXED-BED ADSORBER AND ONE-DIMENSIONAL GROUND WATER SYSTEMS,

New Jersey Agricultural Experiment Station, New Brunswick.
C. G. Uchrin, and T. E. Lewis.
Journal of Environmental Science and Health JESEDU, Vol. A21, No. 3, p 267-279, 1986. 2 fig, 12 ref.

Descriptors: *Mathematical models, *Path of pollutants, *Wastewater treatment, *Sorption, *Packed beds, Computer models, Groundwater pollution, Water treatment.

A mathematical model was written in BASIC for a one-dimensional flow through system with reversible, linear equilibrium sorption characteristics. The model predicts the response of a flow-through, packed bed system to step function input changes. The program's capabilities are demonstrated by calibration to experimental data from a paradichlorobenzene/water/sand system. The computer algorithm is also useful for groundwater contamination problems. (Peters-PTT)
W86-05465

DIFFERENCES IN IONIC COMPOSITIONS AND BEHAVIOR IN WINTER RAIN AND SNOW,

Environmental Monitoring and Services, Inc., Newbury Park, CA.
L. E. Topol.
Atmospheric Environment ATENBP, Vol. 20, No. 2, p 347-355, February 1986. 1 fig, 6 tab, 18 ref, append.

Descriptors: *Rain, *Snow, *Acid rain, *Winter, *Northeastern United States, *Sulfate, *Nitrate, Acid precipitation, Ammonium, Monitoring network, Scavenging.

Winter (November-March) precipitation for 1978-1981 at nine sites in the northeastern United States showed statistically significant (5% level) differences in the concentrations of sulfate and nitrate in rain and snow. The results were analyzed on a precipitation-weighted means basis for each site and on a total sample basis for the whole network. Overall, snow contained higher precipitation-weighted mean concentrations of nitrate than did rain in winter (rain/snow ratio = 0.72), whereas the opposite occurred for sulfate (rain/snow = 1.38). In addition, snow showed higher molar concentrations of nitrate than sulftage (sulfate/nitrate ratio = 0.48 for snow vs 1.02 for rain). Sites and samples with the highest network rain acidities tended to have the highest network sulfate and nitrate concentrations, whereas sites with the highest snow acidity tended to have the highest nitrate concentrations. Acidity in both rain and snow was strongly correlated with 2SO4(2-) + NO3- - NH4+. The higher NO3(-)/SO4(--) ratios in snow than in rain are consistent with other recent measurements in Long Island, NY and Wales. The results suggest that the difference in scavenging of nitrate and sulfate by rain and snow is widespread and is due to the more effective capture of nitrate vapor than particulate nitrate or sulfate by snow. (Rochester-PTT)
W86-05466

RECENT PATTERNS OF SULFATE VARIABILITY IN PRISTINE STREAMS,

Geological Survey, Reston, VA.
H. F. Lins.
Atmospheric Environment ATENBP, Vol. 20, p 367-375, February 1986. 6 fig, 2 tab, 12 ref.

Descriptors: *Stream sulfate, *Principal component analysis, *Acid rain, *Sulfate deposition, *Sulfur dioxide emissions, *Eastern United States, Air pollution, Water pollution, Pristine streams.

Systematic modes of spatial and temporal variation in a 13-yr record of stream sulfate from a nationwide network (United States) of headwater sampling stations are defined using principal components. Based on the undisturbed nature of the sampling network, it is suggested that these modes of stream sulfate variability are analogues for variations in acid deposition. Three statistically significant components, accounting for approximately 50% of the total stream sulfate variance, are identified. Analysis of component loadings and scores indicates that a major transition occurred in the early 1970s when stream sulfate concentrations in the northeast changed from persistently above mean levels to persistently below. At the same time, concentrations of sulfate in Gulf and Southeast Atlantic coast streams shifted from persistently below to persistently above mean concentrations. Significantly, these changes occurred contemporaneously with regional trends in sulfate emissions, which generally can be characterized as decreasing in the northeast and increasing in the southeast. (Author's abstract)
W86-05467

ENVIRONMENTALLY SIGNIFICANT VOLATILE ORGANIC POLLUTANTS IN HUMAN BLOOD,

New Orleans Univ., LA. Center for Bio-Organic Studies.
For primary bibliographic entry see Field 5A.
W86-05478

TRACE ELEMENTS IN SEDIMENTS, WATER, AND AMERICAN COOTS (FULICA AMERICANA) AT A COAL-FIRED POWER PLANT IN TEXAS, 1979-1982,

Georgia Univ., Athens. School of Forest Resources.
D. H. White, K. A. King, C. A. Mitchell, and B. M. Mulhhern.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 3, p 376-383, March 1986. 4 tab, 16 ref.

Descriptors: *Water pollution sources, *Birds, *Trace elements, *American coot, *Texas, *Powerplants, *Fly ash ponds, *Sediments, Lead, Copper, Zinc, Nickel, Cadmium, Mercury, Molybdenum, Arsenic, Selnium, Texas, Coal-fired powerplants, Thermal powerplants, Bioaccumulation, Bird censuses.

Temporal accumulation of trace elements (Pb, Cu, Zn, Ni, Cd, Hg, Mo, As, and Se) was determined in water, sediments, and water birds at the ash pond of a coal-fired power plant in Fannin, Texas, and use of the pond by aquaitc bonds was documented. Geometric means of element concentrations in water samples were very low in all collection periods; concentrations of some elements in water appeared to increase with time. Element concentrations in sediments were much higher than in water and also appeared to increase temporally. Elements did not accumulate to alarming concentrations in American coot collected at the ash pond after plant start-up and there was no recognizable pattern of residue accumulation in tissues over time. For most collections, geometric mean concentrations were similar for samples taken at the ash pond and at a control pond. Although some elements were statistically higher in power-plant coots than in controls (e.g., copper at 1 yr post-start-up (9.4 ppm) vs. control site (5.2 pp m)), the overall concentrations were below known-effect levels in birds and probably were biologically insignificant. During biweekly censuses throughout the 3-yr study period, 114 bird species used the 77-ha pond as a resting and feeding site; the American coot was the most abundant. (Rochester-PTT)
W86-05479

LEVELS OF CHEMICAL VERSUS BIOLOGICAL METHYLATION OF MERCURY IN SEDIMENTS,

Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
M. Berman, and R. Bartha.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 3, p 401-404, March 1986. 1 tab, 13 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Mercury, *Salt marsh sediments, *Methylmercury, *Abiotic processes, Hydrogen ion concentration, Temperature, Mercuric chloride, Methylation.

Two approaches were used to compare the contributions of biochemical versus chemical mercury methylation: (1) its level in anoxic saltmarsh sediments incubated at favorable pH and tenmperature was compared to methylation ayt pH (2, 14) and temperature values (60 C) hostile to life and (2) Hg methylation in normal sediment was compared to that in stream-sterilized sediment incubated either at normal or elevated temperatures. Sediments were spiked before incubation with 10 ppm HgCl2 (calculated on a dry sediment basis); unspiked sediment had < 3 nanogram/g methylmercury, whereas biochemical methylation under similar conditions from up to 288 ppb. Compared to biochemical methylation, the environmental significance of abiotic Hg methylation is minor. (Rochester-PTT)
W86-05480

MERCURY RESISTANT BACTERIA ISOLATED FROM SEDIMENT,

Guelph Univ. (Ontario). Dept. of Environmental Biology.
For primary bibliographic entry see Field 5C.
W86-05481

METABOLITES OF XENOBIOTICS IN THE BILE OF FISH IN WATERWAYS POLLUTED BY PULPMILL EFFLUENTS,

Joensuu Univ. (Finland). Dept. of Biology.
A. O. J. Oikari.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 3, p 429-436, March 1986. 3 fig, 1 tab, 11 ref.

Descriptors: *Chlorophenols, *Water pollution sources, *Path of pollutants, *Resin acids, *Kraft mills, *Perch, *Roach, *Bleached kraft mill effluent, *Bioaccumulation, Finland, Metabolism, Pulp and paper industry, Bioindicators, Effluents, Fish.

Concentrations on chlorophenolic (CP) substances and chlorinated and unchlorinated resin acids (RA) were determined in field-collected roach (Rutilus fluviatilis L.) obtained near a pulpmill in Finland that continuously released bleached kraft mill effluent (BKME). The concentrations of free CP and RA in the bile of fish living 0.1-6 km downstream from the effluent pipe ranged from 1-8 micro/ml fro CP and 1-9 micro/ml for RA. The average total concentrations of conjugated CP and RA in the fish bile were up to 100-200 times higher than for the free substances. The roach, possibly being a fairly local species, nicely reflected the average concentration of the xenobiotics in the animals' usual cruising area. Unlike the roach, results for perch did not reveal a consistent relationship be-

tween the distance from the BKME source and the bile concentrations of CP conjugates. In contrast, the behavior of RA conjugates in perch was ideal, ie, their level steadily decreased with increasing distance from the pulpmill effluent pipe. (Rochester-PTT)
W86-05482

BIOACCUMULATION OF 14C-HEXACHLROBENZENE IN EGGS AND FRY OF JAPENESE MEDAKA (ORYZIAS LATIPES),

Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
Y. Huang, G. R. Biddinger, and S. P. Gloss.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 3, p 437-443, March 1986. 4 fig, 12 ref.

Descriptors: *Hexachlorobenzene, *Bioaccumulation, *Path of pollutants, *Japanese medaka, *Eggs, *Fry, Fish, Carbon-14, Isotope studies.

Rates of 14C-hexachlorobenzene (HCB) bioaccumulation during early life stages of Japenese medaka were examined after short-term (24 hr) and long-term (14-day) aqueous exposure. The concentration of 14C-HCB during the experiments ranged from 60-80 nanogram/L, based on daily monitoring. Short-term accumulation of HCB by medaka eggs of different ages was low, increasing only slightly during development. The amount of uptake increased after hatching and approached 5 times more than that of the eggs. Long-term accumulation in eggs increased linearly over time, but did not reach a steady state by hatching (13 days). Twenty-four-hour accumulation of HCB by fry was highest in larvae 10-12 mm long and 15-30 mg in weight, a size corresponding to the late metalarval and early juvenile phases. Long-term uptake by fry (avg initial weight 25.3 + or - 3.2 mg (SE) was initially rapid, burt decreased as exposure time increased. Uptake equilibrium of 14HCB was reached after 10 days exposure and a bioaccumulation factor of 3.13 x 10(4) (equilibrium concentration 2,500 nanogram/g wet weight). (Rochester-PTT)
W86-05483

NONACCUMULATION OF CHLORINATED DIOXINS AND FURANS BY GOLDFISH EXPOSED TO CONTAMINATED SEDIMENT AND FLYASH,

New York State Office of Public Health, Albany. Wadsworth Center for Labs. and Research.
P. W. O'Keefe, D. R. Hilker, R. M. Smith, K. M. Aldous, and R. J. Donnelly.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 3, p 452-459, March 1986. 3 tab, 15 ref. Health Research, Inc. Grant No. 65038-01.

Descriptors: *Goldfish, *Bioaccumulation, *Dioxins, *Furans, *Path of pollutants, *Sediments, *Fly ash, Love Canal, Municipal incincerator, Cayuga Creek, New York, Landfills, Storm sewers, Tetrachlorodibenzo-p-dioxin, Tetrachlorodibenzofuran, Toxins.

An attempt was made to observe bioaccumulation of dioxins and furans from contaminated sediments and municipal incinerator fly ash in large (70-300 g) goldfish (Carassius auratus). A number of tetrachlorodibenzo-p-dioxins (TCDD) and tetrachlorodibenzofurans (TCDF) were found in the incinerator fly ash, with the 2,3,7,8-substituted isomers accounting for approximately 10% of total tetra isomers. The sediment contained 2,3,7,8-TCDD as the only TCDD isomer, with a trace of 2,3,7,8-TCDF; the sediment was collected from Cayuga Creek, a small stream that recieves discharges from a storm sewer system surrounding the Love Canal, New York, chemical dump site. Concentrations of 2,3,7,8-TCDD and 2,3,7,8-TCDF in fly ash and sediment in aquaria showed a 40-50% reduction after 6-10 wk, but there was no evidence of uptake by clean sand in the aquaria. The difference between estimated and analytical values in goldfish flesh did not exceed 30% when fortified with 13 ppt 2,3,7,8-TCDD and 2,3,7,8-TCDF. Unfortified samples showed no evidence of contamination with 2,3,7,8-TCDD or 2,3,7,8-TCDF at limits of detection of 2.4 and 1.1 ppt, respectively. Neither compound was detected in the fish and water samples taken after 10 wk exposure to the contaminated matrices. In contrast, fish (carp/goldfish, sunfish) collected in Cayuga Creek near the sediment sampling point contained more than 30 ppt 2,3,7,8-TCDD. (Rochester-PTT)
W86-05485

EFFECTS OF PH ON THE ENVIRONMENTAL FATE OF (14C) ALDICARB IN AN AQUATIC MICROCOSM,

Ohio State Univ., Columbus.
K. E. Suorsa, and S. W. Fisher.
Ecotoxicology and Environmental Safety ECOLAR, Vol. 11, No. 1, p 81-90, February 1986. 3 fig, 2 tab, 28 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Aldicarb, *Hydrogen ion concentration, *Insecticides, Gambusia affinis, *Bioaccumulation, *Metabolism, Midges, Aldicarb sulfone, Aldicarb sulfoxide, Carbon-14, Bioassay, Isotope studies, Algea, Snails, Mosquitoes, Aquatic insects, Carbamate pesticides.

The role of pH in determining the environmental fate of (14c) aldicarb was examined in an aquatic microcosm. Only minor amounts of the radiochemical were absorbed by aquatic organisms at any pH. Of the radioactivity absorbed, greater than 75% was metabolized rapidly and incorporated into tissues. Minor distances in the in vivo spectrum of aldicarb and metabolites as a function of pH were discerned for fish (Gambusia affinis); the quantitative and qualitative distribution of aldicarb and its metabolites was identical for the other organisms (Oedogonium cardicacum, Chironomus-riparius, ZHelisoma spp, Aedes aegypti) across the pH levels. The most notable difference in metabolite spectrum appearing in the water as a function of pH was the absence of aldicarb sulfone at pH 4 on day 6. In contrast, aldicarb sulfoxide was found as the major metabolite and aldicarb was completely lacking at all three pH levels. Since aldicarb sulfoxide is biologically active, disappearance of the parent compound does not eliminate hazard. The general effects of pH on the environmental fate of aldicarb are negligible on day 6, but may be more pronounced at other time periods. (Rochester-PTT)
W86-05493

AQUEOUS OXIDATION OF SO2 BY OH RADICALS,

Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
W. J. McElroy.
Atmospheric Environment ATENBP, Vol. 20, No. 2, p 323-330, February 1986. 3 fig, 5 tab, 27 ref.

Descriptors: *Acid rain, *Path of pollutants, *Aqueous hydroxyl radicals, *Bisulfite ion, *Sulfates, *Acid precipitation, *Sulfur dioxide, *Troposhpere, Reaction kinetics, Free radical reactions, Cloud chemistry.

The reaction of aqueous hydroxyl radicals with bisulfite ion has been proposed as a significant, and in some cases, a primary pathway by which SO2 is oxidized to sulfate in tropospheric cloud. In view of the importance being attributed to this process as a means of producing sulfate in precipitation, the associated kinetics and mechanism of this oxidation reaction were examined. Illustrative computations indicate that reaction schemes taking account of the aqueous oxidation of SO2 by OH in existing models of cloud chemistry are inconsistent with the mechanisms on which they are based and yield a wide range of oxidation rates. Calculations are presented that suggest that the reaction of the SO(5-) radical with bisulfite ion is rate determining, although the rate constant remains uncertain. The products of this reaction must be identified before the mechanisms of sulfate production can be elucidated and the relevance of this process to tropospheric SO2 oxidation reliably assessed. (Rochester-PTT)
W86-05495

ESTIMATION OF NIGHT-TIME N205 CONCENTRATIONS FROM AMBIENT NO2 AND NO3 RADICAL CONCENTRATIONS AND THE ROLE OF N205 IN NIGHT-TIME CHEMISTRY,

California Univ., Riverside. Statewide Air Pollution Research Center.
R. Atkinson, A. M. Winer, and J. N. Pitts, Jr.
Atmospheric Environment ATENBP, Vol. 20, No. 2, p 331-339, February 1986. 2 fig, 1 tab, 32 ref. California Air Resources Board Contract A3-0490-32, NSF Grant ATM-8410795-01.

Descriptors: *Acid rain, *Path of pollutants, *Dinitrogen pentoxide, *Nitrates, *Nitrous oxide, *Acid precipitation, *Nitrpogen oxides, *Night-time atmosphere, Atmospheric chemistry, United States, Germany, Reaction kinetics.

Dinitrogen pentoxide (N205), which is present in equilibrium with NO3 radicals and NO2, has been recognized for some time as an intermediate in the NOx chemistry of night-time atmospheres. However, until the advent of long pathlength spectroscopic techniques for the measurement of atmospheric NO3 radical concentrations, no reliable method for estimating N205 concentrations has been available. Maximum night-time N205 concentrations were calculated from the avaliable experimentall-determined concentrations of the NO3 radical and NO2 in the United States and Germany. It was found N205 concentrations as high as 15 ppb can occur. Removal rates for N205 and for NO3 radicals also have been estimated for these nights. From data obtained under conditions devoid of point sources NOx, upper limit estimates of the homogeneous rate constant for the reaction of N205 with water vapor are obtained, leading to the conclusion that the homogeneous gas phase rate constant for this reaction is < or > 1 x 10 (-21) cu cm per molecule per sec at 298 K, consistent with recent environmental chamber data. (Author's Abstract)
W86-05496

WATER QUALITY SIMULATION STUDY OF A NATURAL HARBOR,

Birmingham Univ. (England). Dept. of Civil Engineering.
R. A. Falconer.
Journal of Waterway, Port, Coastal, and Ocean Engineering (ASCE) JWPED5, Vol. 112, No. 1, p 15-34, January 1986. 9 fig, 3 tab, 20 ref, append.

Descriptors: *Water quality simulation, *Harbors, *England, *Nitrogen removal, *Hydrodynamics, Mathematical Models, Depth, Water currents, Wastewater treatment plants, Boundary conditions, Nitrate nitrogen, Ammonium nitrogen, Advection, Flooding, Tides.

A hydrodynamic water quality model was used to predict water elevations, the depth average velocity components, and the depth mean nitrogen concentrations in Poole Harbor and Holes Bay, in Dorset, England. The main objective of the study was to ascertain the influence of the nitrogen discharge from Poole Sewage Treatment Works on the corresponding concentrations across the harbor. Comparisons were undertaken, both with and without nitrogen inputs from Poole Sewage Treatment Works, of the concentration distributions of total oxidized nitrogen and ammoniacal nitrogen across the harbor, for inflows from two rivers and three sewage treatment works. limited field measurements of velocities and nitrogen concentrations were available, allowing a check on the accuracy of the model predictions. A number of difficulties had to be ovvercome in the hydrodynamic modeling, including treatment of the open boundary conditions, representation of the advective terms, with particular reference to the narrow harbor entrance, and simulation of extensive flooding and drying of shallow regions throughout the tidal cycle. Nitrogen removal from the sewage treatment works had a marked effect on the N levels in Holes bay (50% reduction) but not in Poole Harbor (10% reduction). (Rochester-PTT)
W86-05500

FIELD EVIDENCE FOR AN ACID RAIN EFFECT ON LICHENS,

Sheffield Univ. (England). Dept. of Landscape Architecture.
For primary bibliographic entry see Field 5C.
W86-05511

LEAD CONCENTRATIONS IN BULLFROG RANA CATESBEIANA AND GREEN FROG R. CLAMITANS TADPOLES INHABITING HIGHWAY DRAINAGES,

Patuxent Wildlife Research Center, Laurel, MD.
C. W. Birdsall, C. E. Grue, and A. Anderson.
Environmental Pollution (Series A) EPEBD7, Vol. 40, No. 3, p 233-247, 1986. 3 fig, 1 tab, 40 ref.

Descriptors: *Bullfrog, *Sediments, *Green frog, *Tadpoles, *Lead, *Highways, Traffic volume, Virginia, Maryland, Bioaccumulation, Predation, Ponds, Wildlife, Runoff.

Lead concentrations were determined in sediment and tadpoles of bullfrogs and green frogs from drainages along highways in Maryland and Virginia with different daily averages traffic volumes (range: 4,272-108,800 vehicles / day) and from ponds at least 0.4 kn from the nearest highway. Lead concentrations (mg/kg dry weight) in sediment (7.8-940) were usually greater than those in the tadpoles (bullfrog: 0.07-270; green frog, 0.90-240). Lead concentrations in sediment (r=0.63) and in both species of tadpoles (bullfrog: r=0.69, green frog, r=0.75) also were positively correlated with average daily traffic volume. Lead concentrations in both species of tadpoles (bullfrog, r=0.76; green frog, r=0.75) also were positively correlated with lead concentrations in sediment. At sites where both bullfrog and green frog tadpoles were collected, lead concentrations in the two species were closely related (r=0.84). The variation of lead concentrations in sediment and tadpoles observed at the various sites may be due to several factors: 1) seasonal differences in lead inputs from runoff; 2) microtopography and the resultant residence time of standing water, e.g. sediments in streams contained less than pond sediments; and 3) composition of the substrate. (Rochester-PTT)
W86-05512

TECHNICAL NOTE: EXPERIMENTAL DETERMINATION OF THE CALCIUM CARBONATE SATURATION STATES OF WATER SYSTEMS,

Environmental Science and Engineering, Inc., Gainesville, FL.
R. A. Pisigan, and J. E. Singley.
American Water Works Association Journal JAWWA5, Vol. 77, No. 10, p 92-94, October 1985. 3 fig, 18 ref.

Descriptors: *Calcium carbonate, *Water chemistry, Water analysis, Pipes, Mathematical study, Hydrogen ion concentration, Alkalinity, Chemical properties, Saturation index.

The Langelier saturation index (SI) was originally developed to assess the tendency of a water to deposit or dissolve the calcium carbonate coating on pipes. It can be expressed as the logarithm of the ratio of hydrogen activity at CaCo3 saturation to the actual hydrogen activity of the water. When the SI is positive, the reaction is not spontaneous. Equilibrium experiments were done to characterize the behavior of the pH, alkalinity, and calcium level over time after a water sample had been treated with 0.25 + or - 0.03 g of analytical-reagent-grade CaCO3 powder and the container completely filled with water had been agitated. Two samples were used: tap water from Gainesville, Fla., and deionized water. The equilibration experiments suggest that in a water with a slight tendency to dissolve calcium carbonate and in a water with a high dissolving tendency, pH, alkalinity, and calcium do not change significantly after 24 h. The SI only indicates the tendency to dissolve or precipitate CaCO3 - the rate of attainment of equilibrium cannot be derived from the SI value. (Main-PTT)
W86-05513

SPATIAL AND TEMPORAL PATTERNS OF DIELDRIN POLLUTION IN THE HOLME CATCHMENT, WEST YORKSHIRE, ENGLAND,

Huddersfield Polytechnic (England). Dept. of Chemical and Physical Sciences.
M. Boryslawskyj, A. C. Garrood, and M. J. Morphy.
Environmental Pollution EPSPDH, Vol. 10, No. 2B, p 129-139, 1985. 3 fig, 5 ref.

Descriptors: *Path of pollutants, *Water pollution sources, *Dieldrin, *England, Spatial distribution, Temporal distribution, Textile mill wastes, Gas chromatography, Organochlorine insecticides, Insecticides, Path.

West Yorkshire is one of the few remaining areas in England where persistent organochlorine insecticides such as dieldrin are used for the mothproofing of textiles. Concentrations of dieldrin in the River Holme catchment were measured during 1980-81. A study of both spatial and temporal patterns of dieldrin concentration was undertaken. The spatial pattern revealed that the concentration decreased with the distance downstream of recognized discharges and that dieldrin was absent at detectable concentrations elsewhere in the system. At selected stations, a detailed temporal survey was carried out and revealed that, close to the pollution source, massive changes in dieldrin concentration occurred over short time periods. As distance from the source increased, these changes were much less marked. Analyses were carried out on a gas chromatograph. It is clear from the results of the temporal survey that occasional spot measurements of dieldrin, taken near the source of input, can only be of limited value. (Main-PTT)
W86-05527

EVALUATION OF SELECTED SEDIMENT PARAMETERS AS A RAPID MEANS OF ASSESSING THE IMPACT OF ORGANIC WASTE DISCHARGES TO TIDAL WATERS,

Scientific Services, Kent (England).
J. R. Wharfe, K. Friend, and R. A. Dines.
Environmental Pollution EPSPHD, Vol. 10, No. 3B, p 159-172, 1985. 8 fig, 3 tab, 19 ref.

Descriptors: *Sediments, *Organic wastes, *Tidal waters, *Path of pollutants, Marine sediments, Seasonal variation, England, Oxidation-reduction potential.

During ecological studies in the vicinity of a number of waste discharges to the North Kent coast the spatial and seasonal variations of sediment redox potential profiles and organic carbon content were examined. Redox potential measurement was achieved by a platinum rod electrode of 8 mm external diameter coupled with a calomel reference half-cell. Sediment cores were transported to the laboratory in plastic tubes and redox potentials measured at 2 cm intervals, to a depth of 10 cm, within 6 h of collection. The same procedures were used with samples collected monthly to investigate seasonal variability. The predominance of fine particles of <0.25 mm diameter is typical of the bottom sediments of the Swale and Milton Creek. All sites showed a reduction in redox potential with increased depth. Redox potentials varied with time at different depths in sediment profiles. Sediment redox conditions at the four sampling locations were dependent on their proximity to organic waste inputs. Redox potentials at all sites varied annually by 100-200 mV. In areas where the bottom deposits are reasonably stable, the degree of reproducibility which can be achieved and the simplicity of the techniques permit the rapid generation of results and facilitate contour mapping to delineate the boundary effects of organic waste discharges. (Main-PTT)
W86-05528

APPLICATIONS OF VOLTAMMETRY IN ENVIRONMENTAL SCIENCE,

Trinity Coll., Dublin (Ireland). School of Botany.
For primary bibliographic entry see Field 5A.
W86-05529

ROLE OF THE OCEAN IN A REGIONAL SULFUR CYCLE,

National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
For primary bibliographic entry see Field 2K.
W86-05536

ACID RAIN FALLS ON BRITISH WOODLANDS,

C. Rose.
New Scientist NWSCAL, Vol. 108, No. 1482, p 52-53, 55-57, November 14, 1985.

Descriptors: *Acid rain, *Forests, Rainfall, Inorganic acids, Atmospheric deposition, Sulfur dioxide, Nitrogen oxide, Environmental effects, England.

There is ever increasing evidence that air pollution is to blame for acid rain. Both primary pollutants (such as sulfur dioxide and nitrogen oxide emitted directly from engines or furnaces) and the secondary pollutants formed from them are involved. At least half a dozen chemical pollutants are known to occur at damaging levels in many European countries, and some exert a cumulative or progressive effect as well as episodes of peak damage. The pollutants can also act together. For several years, British environmental groups have received reports of tree damage from visiting foresters and ecologists. In 1984, the Forestry Commission launched a survey of forest damage. To date, results of the Commission's study has failed to explain the widespread occurrence of symptoms that are strikingly similar - if not identical - to those attributed to acid rain on the continent and in North America. It may well be that damage to British trees, as with freshwater, has been taking place in some areas for decades. A gradual decline may explain the Commission's view that it is not seeing anything unusual. (Khumbatta - PTT)
W86-05542

PRETREATMENT STANDARDS FOR HAZARDOUS WASTES,

For primary bibliographic entry see Field 5D.
W86-05545

RADIOACTIVITY LEVELS IN MUNICIPAL SLUDGE,

Battelle Columbus Div., OH.
For primary bibliographic entry see Field 5E.
W86-05546

BACTERIOLOGICAL QUALITY OF SELECTED BACKCOUNTRY DRINKING WATER SOURCES IN PISGAH NATIONAL FOREST,

Winthrop Coll., Rock Hill, SC. Dept. of Biology.
R. A. Gustafson, and J. E. Dille.
Journal of Environmental Health JEVHAH, Vol. 48, No. 5, p 244-249, March-April 1986. 1 fig, 6 tab, 36 ref.

Descriptors: *Wilderness areas, *Springs, *Streams, Pisgah National Forest, *Drinking water, *Escherichia coli, *Enteric bacteria, *Streptococcus, North Carolina, Coliforms.

The drinking water sources, springs and streams, at five backcountry camping sites in the Pisgah National Forest of North Carolina were evaluated for sanitary quality. Total bacteria, total coliforms, fecal coliforms, and fecal streptococci were enumerated using several procedures. Coliforms were detected in 20% of the 10 spring samples and 85% of the 20 stream samples. Fecal coliforms were present in 10% of the spring samples and in 60% of the stream samples. Fecal streptococci were present in 60% of the spring samples and in all of the stream samples. Nearly one-half of the coliforms isolated from the water sources were identified as Escherichia coli (IMViC ++-- and -+--). The remaining isolates were distributed among 10 other IMViC reactions with the -+-+ type being most common. (Author's Abstract-PTT)
W86-05547

CHEMICAL COMPOSITION OF VEGETABLES GROWN ON AN AGRICULTURAL SOIL AMENDED WITH SEWAGE SLUDGES,

West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
R. F. Keefer, R. N. Singh, and D. J. Horvath.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 146-152, April-June 1986. 11 tab, 25 ref.

Descriptors: *Heavy metals, *Sewage sludge, *Vegetables, *Land application, Soil amendments, Radish, Carrot, Cabbage, Green beans, Sweet corn, Tomatoes, Cadmium, Chromium, Lead, Nickel, Copper, Zinc, Sandy loam, Soils.

Heavy metals were analyzed in edible and nonconsumable parts of radish (Raphanus sativus L. cv White Icicle), carrots (Daucus carota cv Chantenay), cabbage (Brassica oleracea var. capitata L. cv Market Topper), green beans (Phaseolus vulgaris cv Tenderette), sweet corn (Zea mays L. Rugosa cv Silver Queen), and tomatoes (Lycopersicon esculentum cv West Virginia '63) grown on sandy loam soil to which four sewage sludges were applied in the field at 90 and 180 mg/ha. Cd, Cr, and Pb concentrations in the edible parts of the vegetables from sludge-treated plots were no more than 1.0 mg/kg above those from untreated control plots. However, considerably more of these elements accumulated in radish tops, bean leaves, and corn leaves grown on a soil treated with two of the sludges. Ni concentrations in vegetables from plots receiving two of the sludges were significantly higher than in the controls for both edible and nonconsumable parts of most of the vegetables grown on a plot treated with sludge that was relatively low in total Ni (270 mg/kg) than with a sludge that contained more than 47 times as much Ni. Cu and Zn levels in vegetables grown on some sludge-treated soils were evaluated, but not high enough to cause alarm. The results emphasize the need for more information about sewage sludge than just total elemental analysis prior to application onto land on which vegetables will be grown. (Author's Abstract)
W86-05552

METALS IN LOW-ELEVATION, SOUTHERN APPALACHIAN FOREST FLOOR AND SOIL,

Emory Univ., Atlanta, GA. Dept. of Biology.
For primary bibliographic entry see Field 2K.
W86-05553

TIME-DEPENDENT CHANGES IN SOLUBLE ORGANICS, COPPER, NICKEL, AND ZINC FROM SLUDGE AMENDED SOILS,

Washington State Univ., Pullman. Dept. of Soil Science.
L. M. Dudley, B. L. McNeal, and J. E. Baham.
Journal of Environmental Quality JEVQAA, Vol. 15, No. 2, p 188-192, April-June 1986. 4 fig, 4 tab, 25 ref.

Descriptors: *Sludge disposal, *Sludge utilization, *Copper, *Nickel, *Zinc, *Carbon, *Ammonium, *Nitrate-Nitrogen, *Orthophosphates, *Hydrogen ion concentration, *Solubility, *Organic matter, Washington, Soil acidity, Nitrification, Oxidation, Soil water.

An acidic western Washington state soil and a near-neutral eastern Washington soil were each mixed with anaerobically-digested Seattle-METRO sewage sludge and incubated in triplicate at 25 + or - 2 c and approximately -33 kPa water potential for 1, 2, and 4 days and 2, 2, 4, 10, and 30 weeks. At the end of each incubation period, saturation pastes were made using 0.01 M CaC12 and vacuum extracted. Total soluble C, Cu, Ni, and Zn, as well as NH4 + NH3, NO-N, ortho-P, and pH were measured in the extracts. High NH4 + NH3 values produced in the first 2 weeks of incubation caused the pH to increase into the alkaline range. Soluble C values increased during this period, and soluble Cu values increased despite the increasing pH , apparently because of inorganic complex formation. Soluble Zn declined during the same period. Soluble Ni possessed intermediate chemical behavior, as it appeared to be influenced both by a solid phase with pH-dependent solubility and by ability to form organic complexes. Nitrification during incubations longer than 4 weeks lead to a pH decline and increased Zn and Ni levels once more. Decreasing Cu levels were also associated with this period, probably due to losses of soluble organic materials via oxidation. (Author's Abstract)
W86-05554

ACCUMULATION OF CADMIUM BY WHITE SUCKERS (CATOSTOMUS COMMERSONI) IN RELATION TO FISH GROWTH AND LAKE ACIDIFICATION,

Toronto Univ. (Ontario). Dept. of Zoology.
L. I. Bendell-Young, H. H. Harvey, and J. F. Young.
Canadian Journal of Fisheries and Aquatic Science CJFSBX, Vol. 43, No. 3, p 806-811, March 1986. 3 fig, 3 tab, 27 ref.

Descriptors: *Acid rain, *Cadmium, *Growth, *Lake acidification, *Ontario, *Hydrogen ion concentration, *Metal bioavailability, *Acid lakes, Liver, Kidney, Muscle, Bone, Tissue analysis, Canada, Catostomus commersoni, Lake sediments, George Lake, Red Chalk Lake, Circumneutral lakes.

The liver, kidney, muscle, and bone tissues of white suckers (Catostomus commersoni) captured from six lakes in south-central Ontario (Canada) were analyzed for Cd content. The lakes ranged in pH from 4.8 to 6.4 and contained elevated Cd concentrations in recently deposited sediments. Cd was found to be bioaccumulating in the livers of fish from both acid and circumneutral lakes, with fish from (acid) George Lake (ages 2-5) and (Neutral) Red Chalk Lake (ages 7-14) containing similar concentrations. Calculated growth constants for each of the six populations revealed considerable variations in fish growth rates. A method is presented which represents the age, weight, and tissue Cd concentrations data for the six populations such that interlake comparisons of metal bioavailability can be made with the possible effects that the different fish growth rates may have on rates of metal accumulation factored out. When presented in this manner, our results imply that, on the linear portion of the growth curve, the growth rates for each population, and not effects due to lowered pH, can account for the concentrations of Cd in five of the six fish populations. Therefore, since tissue-metal concentrations in fish from stressed lakes will be dependent on both metal bioavailability and fish growth rates, it is essential that these be reported together. (Author's Abstract)
W86-05560

EVALUATION OF FACTORS RELATED TO THE UNUSUALLY LOW CHLOROPHYLL LEVELS IN PRAIRIE SALINE LAKES,

Alberta Univ., Edmonton. Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W86-05562

TRANSPORT OF 60CO BETWEEN WATER AND SEDIMENTS IN A SMALL SHIELD LAKE,

Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
R. J. Cornett, and I. L. Ophel.
Canadian Journal of Fisheries and Aquatic Science CJ.FSBX, Vol. 43, No. 3, p 877-884, March 1986. 5 fig, 32 ref.

Descriptors: *Cobalt-60, *Path of pollutants, *Radioactive wastes, *Lake sediments, *Isotope studies, *Single reservoir model, Deposition rate, Canada, Perch Lake, Canadian shield, Seasonal variation, Mathematical model, Waste management area, Simulation.

Low levels of 60Co, discharged from a waste management area, have flowed into a small (Canadian) shield lake (Perch Lake) over a period of 22 yr. Constructing a mass balance using measured waterflows, measurements of 60Co activities in the inflow, in the bottom of sediments, and in the lake outlet, provides a unique record of the isotope's behavior. The long-term, annual, and seasonal movements of 60Co between the water, sediments, and the outflow have been examined and compared. An instantaneously mixed, single reservoir model with constant parameters accurately simulated the average annual variations in 60Co activity in the water and in the sediments. The lake sediments were the major sink for 60Co . More than 90% of the 60Co present in the lake system at any one time was found in the sediments. However, less than half of the total 60Co inputs were retained in the sediments over the 22-yr period. The remainder left the lake through the outflow. The fractional rate of 60Co deposition in the sediments was independent of the rate of 60Co inputs and independent of the 60Co activity in the lake sediments. Seasonal changes in 60Co concentrations in the lake were often very large. Spring and summer concentrations were often 50-500% lower than predicted from a model that simulated annual average concentrations. During the winter, 60Co concentrations in the lake water were greater than expected, probably due to the exclusion of 60Co from lake ice, incomplete mixing of lake water, or release of 60Co from the sediments. These seasonal variations in the 60Co activity were accurately simulated by a single reservoir model using different removal rates for the summer and winter periods. (Author's Abstract)
W86-05563

TRACE METALS IN HUMIC ACIDS AND THEIR HYDROLYSIS PRODUCTS,

Central Inst. for Tumors and Allied Diseases, Zagreb (Yugoslavia).
D.J. Huljev.
Environmental Research ENVRAL, Vol. 39, No. 2, p. 258-264, April 1986. 1 fig, 4 tab, 17 ref.

Descriptors: *Path of pollutants, *Trace elements, *Humic acids, *Sava River, *Metal complexes, *Cycling elements, Neutron activation analysis, Amino acids, Proteins, Phenols, Phenolic acids, Carbohydrates, Polycyclic aromatics, Metals, Silver, Iron, Cobalt, Cesium, Europium, Antimony, Selenium, Strontium, Yugoslavia.

The role of humic acids in the transport of trace elements in the Sava River biocycle (near Zagreb, Yugoslavia) was investigated by neutron activation analysis. Humic acids isolated from Sava River sediments were hydrolyzed to their main components, namely amino acids (proteins), phenols (and phenolic acids), carbohydrates, polycyclic aromatics, and metals. Neutron activation analysis was used to measure quantitatively and qualitatively the following trace elements in humic acids and their hydrolysis products: Ag, Fe, Co, Cs, Eu, Sb, Sc, Se, and Sr. The concentrations observed ranged from 0.05 to 2,730 microgram of a single microconstituent per gram of sample. Experimental data were compared with the laboratory experiments on determination of stability constants for metal complexes of humic acids and their hydrolysis products. From these data it is possible to suggest the ecological importance of trace metals bonded to humic acids. The role of humic acids in the cycling of trace elements in the Sava River biocycle is discussed. (Rochester-PTT)
W86-05571

ORGANOCHLORINE RESIDUES IN FRESHWATER FISHES IN NIGERIA,

Benin Univ., Benin City (Nigeria). Dept. of Chemistry.
S. S. Atuma, and C. O. Eigbe.
International Journal of Environmental Studies IJEVAW, Vol. 24, No. 3/4, p 251-254, May 1985. 1 tab, 12 ref.

Descriptors: *Pesticides, *Water pollution, *Organochlorine residues, *Nigeria, *Freshwater fish, Lindane, HCB, DDT, DDE, Bendel State, Mud catfish, Elephant snout fish, African bony tongue, Snake head fish, Catfish, Mormyrus macrophthalmus, Heterotis niloticus, Channa obscura, Chrysichthys nigrodigitatus, Tilipia zilla.

The presence of organochlorine pesticide residues was investigated in fish from various freshwater ecosystems in Bendel State of Nigeria. The fish

species were those commonly used for human consumption (mud catfish, Clarias lazera; elephant snout fish, Mormyrus macrophthalmus; African bony tongue, Heterotis niloticus; snake head, Channa obscura; cat fish, Chrysichthys nigrodigitatus; and Tilipia Zilli). Among the compounds were the DDT group, HCB, and lindane (gamma-benzene hexachloride). The results indicate an appreciable accumulation in fish of P,P-DDT, P,P'-DDE, and lindane. Although the levels of residues found in this study may not be regarded as hazardous, a closer study of the occurrence, distribution, and possible effects of these pesticides in selected biota is recommended. (Rochester-PTT)
W86-05579

REGRESSION MODELS FOR ESTIMATING STORM RUNOFF LOAD AND ITS APPLICATION TO LAKE KASUMIGAURA,

National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
S. Ebise, and T. Goda.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 1/2, p 73-85, June 1985. 7 fig, 4 tab, 5 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Regression models, *Storm runoff, *Lake Kasumigaura, Japan, Phosphorus, Nitrogen, Chemical oxygen demand, Mathematical model, Storms, Runoff rates, Nonpoint pollution sources.

Regression models are proposed for accurate estimation of storm runoff load. Regression equations are obtained for the relationship between final cumulative load and flow during direct runoff by each storm event. The models are applied to estimate annual nutrient load by all influent rivers into Lake Kasumigaura (Japan) for a model year of average annual rainfall. The load in dry weather is calculated from observed data of all influent rivers. Total annual load for a year is the sum of loads in dry weather days and loads in wet weather days. The ratios of load in wet weather day to total annual loads are as follows: 29% for total N, 51% for total P, 53% for total chemical oxygen demand, 22% for dissolved N, 22% for dissolved P, and 30% for dissolved chemical oxygen demand. (Author's abstract)
W86-05584

CHEMICAL MECHANISMS OF ACID GENERATION IN THE TROPOSPHERE,

National Center for Atmospheric Research, Boulder, CO. Atmospheric Chemistry Div.
J. G. Calvert, A. Lazrus, G. L. Kok, B. G. Heikes, and J. G. Walega.
Nature NATUAS, Vol. 317, No.6032, p 27-35, September 5, 1985. 8 fig, 1 tab, 32 ref.

Descriptors: *Acid rain, *Troposphere, *Acid generation, *Path of pollutions, *Chemical reactions, Computer models, Atmospheric deposition, Oxidation, Kinetics, Sulfates, Nitrates, Sulfuric acid, Water pollution sources.

Diverse chemical pathways in the troposphere convert sulfur and nitrogen oxides and organic compounds into acids,involving the gas and liquid phases, and possibly certain suspended aerosols. The rates of acid generation are critically affected by the extent of generation of the oxidizing species and the kinetics of the reactions. Eastern United States precipitation shows a strong variation in the deposition of sulfates in contrast to nitrates and the observed seasonal trends have been rationalized by computer simulations. Recent tropospheric measurements of gaseous hydrogen peroxide show that this gas is a major oxidant leading to sulfuric acid generation in cloud water. (Khumbatta-PTT)
W86-05597

QUANTITATIVE IMPORTANCE OF ALKALINITY FLUX FROM THE SEDIMENTS OF ACID LAKES,

Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
R. Carignan.
Nature NATUAS, Vol. 317, No. 6033, p 158-160, 12 September 1985. 1 fig, 1 tab, 17 ref. NSERC University Research Fellowship.

Descriptors: *Acid rain, *Alkalinity, *Acid water, *Quantitative analysis, *Lake sediments, Alkaline soils, Hydrogen ion concentration, Chemical analysis, Hydrology, Diffusion, Sediment-water interfaces.

The recognition of lake acidification as an important environmental problem has recently stimulated the development of predictive models linking strong acid loading to lake pH or alkalinity. The mass balance approach has been used to predict lake alkalinity from measured stream and precipitation chemistry and from watershed hydrology. This requires that all important positive or negative alkalinity fluxes within the system be considered. Potentially important sources of alkalinity in acid lakes are the diffusive loss of H(+) to the sediments and loss of HCO3(-) from the sediments. The relative importance of these fluxes has generally been overlooked. The flux of alkalinity across the sediment-water interface is estimated here for one lake subject to relatively high acid deposition and shows the significant role of sediment-water interactions in the alkalinity balance of some acid lakes. (Khumbatta-PTT)
W86-05599

THERMAL ANOMALIES DUE TO INJECTION-WELL DISCHARGES IN POROUS AQUIFERS,

Zweckverband Landeswasserversorgung, Stuttgart (Germany, F.R.).
H. Mehlhorn, and H. Kobus.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 593-604, 5 fig, 5 ref.

Descriptors: *Thermal pollution, *Injection well discharges, *Aquifers, *Infiltration rate, Heated water, Cooling water, Buoyancy, Outflow distribution, Groundwater distribution, Rayleigh number.

Infiltration wells discharging industrial cooling water or water from heat pumps give rise to temperature and hence densisty differences in the receiving groundwater. These produce buoyancy effects which may alter the outflow distribution considerably, cause vertical flow near the well and lead to temperature stratification. These effects have been investigated in a three-dimensional numerical flow and heat-transport model and verified by laboratory tank experiments. The results show at which parameter combinations (relative infiltration rate, relative buoyancy and Rayleigh number) stratification is important, or vertically mixed conditions throughout the aquifer are to be expected. The results give a tool for an estimation of the extent of temperature anomalies and thus provide an aid in groundwater management as well as prerequisite for underground heat-budget considerations. (See also W86-05679) (Lantz-PTT)
W86-05683

MODELLING OF THE PROCESSES OF SEEPAGE AND TRANSPORT OF DISSOLVED SOLIDS IN GROUNDWATER,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
M. G. Khublaryan, and I. O. Yushmanov.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 843-852, 2 fig, 9 ref.

Descriptors: *Dissolved solids, *Path of pollutants, *Groundwater pollution, *Mathematical models, *Groundwater movement, Seepage, Groundwater level, Groundwater recharge, Hydrodynamics, Heterogeneity, Anisotropy.

Data on groundwater resources and quality are required for planning groundwater development. A mathematical model allowing the estimation of changes in the groundwater level, movement and dissolved solids content with given parameters of groundwater formation and pollution sources is proposed. The model is based on the combined numerical solution of the unconfined flow problem and the hydrodynamic problem of dissolved solids transport in the saturated zone of heterogeneous and anisotropic porous media. (See also W86-05679) (Author's abstract)
W86-05703

INFLUENCE OF SILICATE GEL INJECTIONS ON GROUNDWATER QUALITY,

Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
M. Barowsky, R. Oetting, and G. Milde.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 971-982, 1 fig, 2 tab, 3 ref.

Descriptors: *Groundwater pollution, *Water quality, *Silicate gel injections, *Soil compaction, Water pollution effects, Soil consolidation, Organic compounds, Heavy metals, Leaching, Inorganic compounds, West Germany.

Groundwater analyses were performed over a period of 25 months in samples from 3 sites which had been treated with silicate gel injections of different concentration and composition. The results were compared to theoretical aspects. Silicate gels often reduce the permeability of the injected medium by several orders of magnitude whereby their consistency may be varied between that of yoghurt and that of sandstone. Soft gels are used for sealing of interstices to maintain foundation trenches dry without a previous lowering of the groundwater table. At present, an annual volume of about 100,000 to 200,000 cu m of soil are solidified with 20,000 to 40,000 tons of chemical solutions in the Federal Republic of Germany including Berlin (West). The tendency is still increasing. Correspondingly, the public interest in a determination of the impact on groundwater and sediments caused by silicate gel injections is increasing. Studies have shown that silicate gel injections are likely to produce groundwater pollution. Even at large scale construction sites, the resulting rise of pH is of minor importance since it will remain limited to the area close to the injection site which is of no importance for water catchment. Rather, there will be a leaching or mobilization of heavy metals, organic compounds or inorganic salts to such an extent that there is no longer an adequate dilution, and the microbial self-purification potentials of the groundwater are continuously surpassed over wide areas. An exact prediction of the effects of silicate gel injections upon groundwater quality is impossible with current knowledge, and for this reason, it is advisable to monitor groundwater quality by suitable means in the event of silicate gel injection, taking into account the extent of such an injection. (See also W86-05679) (Lantz-PTT)
W86-05714

ANALYSIS OF MIGRATION PROCESSES IN GROUNDWATER BY AID OF NUMERICAL MODELS,

Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
P. W. Boochs, C. Bugner, and R. Mull.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 993-1003, 4 fig, 4 ref.

Descriptors: *Groundwater movement, *Groundwater pollution, *Numerical analysis, *Model studies, *Path of pollutants, Hydraulic properties, Water quality, Plumes, Landfills, Environmental effects, Chlorine, Sodium, Iron, Sulfates, Transmissivity, Groundwater recharge.

The evaluation of groundwater contamination requires the application of numerical models to backtrace the development of the plume, to detect the sometimes unknown source and its type, and to determine the influencing hydraulics. By means of

a landfill and its environmental impact, the use of a transport model is demonstrated. The useful connection of experimental investigations and numerical modelling is shown monitoring the contaminant migration at the landfill. Hydraulic data (such as transmissivity and recharge rates) were incorporated into the model, as were water quality data (such as sampling data for Cl(-), Na(+), SO4(--), and Fe(++)(+++)). The collected data were used to determine both the flow-field and the plume of contamination downgradient of the landfill. The transport model served to check which parameters influence the migration process. Furthermore, the temporal propagation of the plume could be determined. (See also W86-05679) (Lantz-PTT)
W86-05716

DETECTION AND ASSESSMENT OF GROUNDWATER CONTAMINATIONS BY ORGANIC CHEMICALS,

Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5A.
W86-05720

IMPACT OF TECHNOGENETIC FACTORS AND WATER WITHDRAWAL ON HYDROCHEMICAL CONDITIONS OF WATER-BEARING SYSTEMS,

Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
V. M. Goldberg.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1055-1062.

Descriptors: *Groundwater mining, *Industrial wastes, *Technogenetic pollution, *Groundwater potential, *Chemical composition, Groundwater, Mineralization, Groundwater pollution, Aquifers, Drinking water, Potable water, Monitoring.

Groundwater production leads to interrelated changes in hydrodynamic and hydrochemical conditions of the aquifer. Prediction of the quality of the withdrawn groundwater involves an assessment of the time of the unconditioned water entrainment to a water intake and an evaluation of changes in the mineralization of the withdrawn water. Partial use of natural unconditioned water can considerably enlarge the groundwater safe yield suitable for a drinking water supply. Groundwater pollution is related to a technogenetic pollution of the environment. To control the groundwater pollution it is necessary to create a specialized system of monitoring and to coordinate the observations of the groundwater state with the observations of the environmental state. (See also W86-05679) (Author's abstract)
W86-05721

METHOD OF WORKING AND EMPLOYMENT OF EDP DURING THE PREPARATION OF GROUNDWATER VULNERABILITY MAPS,

Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
For primary bibliographic entry see Field 7C.
W86-05723

POSSIBLE CHANGES IN GROUNDWATER QUALITY RESULTING FROM RIVER CHANNELIZATION AND IMPOUNDMENT,

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
H. H. Hahn, and G. L. Troubounis.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1087-1103, 5 fig, 2 tab, 17 ref.

Descriptors: *Groundwater quality, *Rivers, *Reservoirs, *Channeling, *Surface-groundwater relations, Chemical composition, Biological properties, Biochemistry, Physical properties, Infiltration, Anaerobic conditions.

Anthropogenic changes of free-flowing river systems, such as impoundment and channelization lead to changes in river geometry, changes in the hydraulic regime and also changes in physico-chemical and bio-chemical reaction characteristics. All this leads to definite and in many instances quantifiable changes of the quality of the surface water. When groundwater is withdrawn from wells close to surface waters, significant amounts of infiltrated surface water enter the well. In this instance, the quality of the infiltrated surface water will affect or control the quality of the pumped water. In this discussion the major effects of the sediments within the river are elaborated, such as the quality of water and its control with respect to accumulation rates of organic matter and quantity of suspended solids. It is argued that increased transport of dissolved substances in the course of infiltration must be expected. The nature of these transported substances will reflect the predominantly anoxic or anaerobic conditions in the sediment layer. (See also W86-05679) (Author's abstract)
W86-05724

EFFECT OF FERTILIZER USE ON GROUND WATER QUALITY IN INDIA,

Central Groundwater Board, Lucknow (India).
B. K. Handa.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1105-1119, 9 fig, 1 tab, 9 ref.

Descriptors: *Groundwater quality, *India, *Fertilizers, Nitrates, Phosphates, Aquifers, Confined aquifers, Well water, West Bengal, Orissa, Assam, Kerala, Groundwater, Humid climates, Water pollution sources.

A comparison of concentrations of nitrates, potassium and phosphate ions present in shallow unconfined and deeper semi-confined to confined aquifers from different parts of India has shown that the former contain generally higher concentrations of these nutrients as compared to the latter. The highest values recorded for these parameters in dug well waters were NO3: 1302 mg/l, K: 1050 mg/l and PO4: 3.65 mg/l. This phenomenon, it is suggested, is due to the phenomenal increase in the use of fertilizers, the consumption of which has risen from 69,000 tons in 1950-51 to 5.26 million tons in 1979-80. There was no correlation between increase in NO3 content and increase in K, due no doubt to the differences in the chemistry of these constituents in the soil. For NO3 and PO4, a weak inverse relationship was observed. Further, in eastern India, viz. in W. Bengal, Orissa, Assam, etc., and in SW India, i.e. in Kerala, due to humid climate, etc. the concentrations of these constituents were lower compared to their concentrations in ground waters from the arid or semi-arid parts of India. (See also W86-05679) (Author's abstract)
W86-05725

SURVIVAL OF SOME PATHOGENIC AND POTENTIAL PATHOGENIC BACTERIA IN GROUNDWATER,

Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
D. Kaddu-Mulindwa, Z. Filip, and G. Milde.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1137-1145, 4 fig, 1 tab, 6 ref.

Descriptors: *Groundwater pollution, *Groundwater quality, *Pathogenic bacteria, Escherichia coli, Salmonella typhymurium, Pseudomanas aeruginosa, Aquifers, Wastewater, Groundwater recharge, Drinking water, Potable water.

Improper draining off of wastewater, sewage and wastewater land application, and an accidental contamination of groundwater during a groundwater recharge, can lead to contamination of aquifers with pathogenic and potentially pathogenic microorganisms. If no inactivation of these microorganisms takes place, the hygienic quality of the groundwater can be affected. It is therefore important for securing unobjectionable drinking water supplies to verify whether, for the dimensioning of the groundwater protection zones, the 50 days die off theory for the bacteria introduced into groundwater aquifers, holds true. In model experiments carried out in the laboratory to verify the survival of some bacteria in groundwater kept at 10 + or - 1 degree C, only two of the tested bacteria did not survive more than 10 - 30 days. In spite of differences in reduction rates, Escherichia coli, Salmonella typhimurium, Pseudomonas aeruginosa and other pathogenic or potentially pathogenic bacteria survived up to 100 days or even longer in groundwater with or without the addition of sand from an aquifer. These findings can be of importance for determining groundwater protection zones. (See also W86-05679) (Lantz-PTT)
W86-05727

GROUND-WATER POLLUTION BY NITRATE,

Bremer Umweltinstitut fuer die Analyse und Bewertung von Schadstoffen (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W86-05729

POLLUTION OF GROUNDWATER FROM DIFFUSE SOURCES,

Umweltbundesamt, Berlin (Germany, F.R.).
H. P. Luhr, and W. Muschack.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1171-1184, 2 tab, 6 ref.

Descriptors: *Groundwater pollution, *Water pollution sources, Industrial pollution, Air pollution, Agricultural pollution, Organic compounds, Hydrocarbons, Roadway pollution, Traffic pollution, Pesticides, Fertilizers, Heat pumps.

Urban and industrialized regions are polluted by noxious substances from various activities or diffuse sources, which may reach the groundwater in precipitations. The sources and activities discussed are: 1) street pollution, 2) air traffic pollution, 3) construction pollution, 4) pollution from agriculture and forestry, 4) gardening, 5) leaky sewage systems, 6) air-transmitted noxious substances, and 7) pollution from crafts and industry. Depending on the degree to which the noxious substances constitute a water hazard, the quality of the groundwater may be irreversibly impaired. This applies particularly to noxious substances which the underground is unable to purify because they are bioaccumulable and persistent. (See also W86-05679) (Lantz-PTT)
W86-05730

PRESENT STATE AND PERSPECTIVES OF REGULAR GROUND-WATER QUALITY MONITORING IN SLOVAKIA,

Slovak Hydrometeorological Inst., Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 5G.
W86-05731

GROUNDWATER CONTAMINATION FROM HAZARDOUS WASTES,

Princeton Univ., NJ. Water Resources Program.
E. F. Wood, R. A. Ferrara, W. G. Gray, and G. F. Pinder.
Prentice-Hall, Inc., Englewood Cliffs, NJ 07632. 163 p.

Descriptors: *Fate of pollutants, *Water quality control, *Landfills, *Groundwater pollution, Leachates, Water pollution sources, Monitoring, Model studies, Mathematical models, Simulation analysis, Hydrology, Geohydrology, Decision making.

This book discusses (on an introductory level) the mechanisms of groundwater contamination from landfills and toxic waste spills. Subjects included are fate of hazardous chemicals (sources, risk assessment, predicting fate, and transformation proc-

esses for mathematical models), numerical simulation of groundwater contamination, monitoring of hazardous waste sites, case studies (groundwater contamination from landfill leachate, from a waste disposal pond, and from improper disposal or accidental spillage of a chlorinated solvent), and factors involved in siting hazardous waste facilities. The appendix reviews basic information on hydrogeology for persons with limited backgrounds in geology. (Cassar-PTT)
W86-05794

RANGELAND WATERSHED WATER BUDGET AND GRAZING CATTLE WASTE NUTRIENT CYCLING,

Oklahoma Agricultural Experiment Station, Stillwater.
J. Powell, F. R. Crow, and D. G. Wagner.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB83-180844, Price codes: A17 in paper copy, A01 in microfiche. Report EPA-600/2-83-017, March 1983. 315 p, 72 fig, 43 tab, 85 ref, 13 append. Contract No. R 803735.

Descriptors: *Water pollution sources, *Fate of pollutants, *Farm wastes, *Animal wastes, *Nonpoint pollution sources, Waste disposal, Range management, Grazing, Cattle, Agricultural runoff, Nutrients, Runoff, Agricultural watersheds, Livestock, Vegetation, Sediments, Oklahoma, Nitrogen, Phosphorus, Potassium.

This research project was designed to determine baseline data concerning the source, movement, concentration and factors affecting nonpoint pollutants in runoff from a representative 60-hectare, tallgrass prairie watershed grazed by cattle in North Central Oklahoma. Measurements were made to determine precipitation and runoff amounts and concentrations of sediment, nitrogen, phosphorus, potassium, BOD, COD and TOC. Concentrations of N, P, K, Ca and structural carbohydrates were determined in live and standing dead vegetation and dung collected periodically from different locations on the watershed. Stocking density and grazing pressure were calculated. Independent site factors were used in regression equations to predict plant species abundance, live and standing dead vegetation biomass, utilization and dung pat density and biomass. The amount of nonpoint source pollution contributed to receiving waters by runoff from the watershed was comparable to that from tallgrass prairie watersheds in other parts of the United States and was minimal when compared to other nonpoint sources of pollution. Significant runoff occurred in every season, but spring was the season with the greatest potential runoff and potential pollution because precipitation and soil water content were greatest and ground cover was lowest at this time. Sediment was the most significant pollutant. Direct overland movement of dung into stream channels was minimal because of standing vegetation and ground litter. (Author's abstract)
W86-05796

REGENERATION OF CHEMICAL ELEMENTS FROM SETTLING PARTICLES COLLECTED BY SEDIMENT TRAP IN FUNKA BAY, JAPAN,

Hokkaido Univ., Sapporo (Japan). Dept. of Chemistry.
S. Noriki, N. Ishimori, and S. Tsunogai.
Journal of the Oceanographical Society of Japan, Vol. 41, No. 2, p 113-120, April 1985. 2 fig, 5 tab, 26 ref.

Descriptors: *Funka Bay, *Trap efficiency, *Sediment yield, *Aluminum, *Path of pollution, Manganese, Sedimentation, Suspension, Particulate matter, Fluctuations, Bays, Japan, Hokkaido, Seasonal variation, Silicate, Cadmium, Iron, Phosphates, Regeneration.

Sediment trap experiments were carried out 39 times from 1977 to 1981 in Funka Bay, Hokkaido, Japan. The observed total particulate flux varied seasonally, that is, the particulate fluxes in winter and spring were larger than those in the summer. The fluxes in all seasons increased with depth. Major components of settling particles were aluminosilicate in winter, biogenic silicate in spring and organic matter and terrestrial material in summer, respectively. The fluxes of each chemical component observed with sediment traps were normalized to that of Al by assuming that the actual flux of Al is equal to the accumulation rate onto the sediment surface. Vertical changes of the normalized flux of each chemical component indicate the following: Fe was not regenerated from the settling particles in the water column. Mn was regenerated in the lower layer exclusively between 80 m depth and the sediment surface. Cd was actively regenerated in the upper layer above 80 m depth. Phosphate was regenerated in the upper layer, while biogenic silicate was in the lower layer. The silicate regeneration, therefore, occurs after phosphate regeneration. The material decomposing in the water column below 40 m has an atomic ratio of P:Si:C=1:52:128. (Author's abstract)
W86-05814

CONTINUOUS MEASUREMENT OF ALGAE BIOMASS BY MEANS OF CHLOROPHYLL FLUORESCENCE IN MONITORING STATIONS IN LOWER SAXONY,

Niedersaechsischen fuer Wasserwirtschaft, Hildesheim (Germany, F.R.).
For primary bibliographic entry see Field 2H.
W86-05819

CONTENTS OF METALS AND SUSPENDED SOLIDS IN THE RHINE. PART II,

BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
K. G. Malle.
Zeitschrift fuer Wasser -und Abwasserforschung ZWABAQ, Vol. 18, No. 5, p 207-209, October 1985. 2 fig, 3 tab, 12 ref.

Descriptors: *Water pollution sources, *Suspended solids, *Metals, *Rhine River, Chromium, Copper, Zinc, Cadmium, Mercury, Lead, Nickel, Germany, Pollution.

The load of Cr, Cu, Zn, Cd, Hg, Pb, and Ni in the Rhine is still decreasing. The decrease mainly occurs in the concentration of the suspended solids. According to the 'Index of Geoaccumulation' of Mueller, the suspended solids in 1983 were 'practically not contaminated' by Hg, Cu, Cr, Ni 'less contaminated to strongly contaminated' by Zn and Pb and 'strongly contaminated' by Cd. A further decrease in Cd contamination by Cd can be expected. (Author's abstract)
W86-05823

BEHAVIOR OF READILY VOLATILE CHLORINATED HYDROCARBONS IN FLOWING WATERS,

Bundesanstalt fuer Gewaesserkunde, Coblenz (Germany, F.R.).
H. Hellmann.
Zeitschrift fuer Wasser- und Abwasserforschung ZWABAQ, Vol. 18, No. 5, p 210-216, October 1985. 14 fig, 6 tab, 10 ref.

Descriptors: *Volatile chlorinated hydrocarbons, *Path of pollutants, *Chlorinated hydrocarbons, Suspended load, Sediments, Biodegradation, Rivers, Adsorption, Water temperature.

The behavior of readily volatile chlorinated hydrocarbons in flowing waters includes different processes such as adsorption on suspended matter and sediments, photochemical and biochemical degradation and transition from the liquid phase into the vapor phase. These processes which may also take place separately are partly in competition with one another. Beyond that, the variations in the concentration of substances at an observation station in the course of a year should be interpreted from hydrological aspects on the basis of detailed numerical data, while taking the changes in discharge and water temperature into consideration. (Author's abstract)
W86-05824

SEVERE HEPATOTOXICITY CAUSED BY THE TROPICAL CYANOBACTERIUM (BLUE-GREEN ALGA) CYLINDROSPERMOPSIS RACIBORSKII (WOLOSZYNSKA) SEENAYA AND SUBBA RAJU ISOLATED FROM A DOMESTIC WATER SUPPLY RESERVOIR,

James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
For primary bibliographic entry see Field 5C.
W86-05828

PERSISTENCE OF PENTACHLOROPHENOL IN A WASTEWATER-ESTUARINE AQUACULTURE SYSTEM,

Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
J. J. Seidler, M. Landau, F. E. Dierberg, and R. H. Pierce.
Bulletin of Environmental Contamination Toxicology BECTAG, Vol. 36, No. 1, p 101-108, January 1986. 2 fig, 24 ref.

Descriptors: *Path of pollutants, *Pentachlorophenol, *Wastewater, *Estuaries, *Aquaculture, Shrimp, Pesticides, Sediments, Zooplankton, Bioaccumulation, Microbial degradation, Phenols.

Approximately 80 million pounds of pentachlorophenol (PCP) and its salts are used each year as biocides. This project was undertaken to examine the accumulation and elimination of PCP in an estuarine aquaculture system receiving sewage as a nutrient source for raising shrimp. PCP accumulation in surface sediment was found, possibly by absorption to detritus settling to the bottom, assimilation into benthic algae and ingestion by zooplankton with deposition in fecal pellets. Loss of PCP in sediment probably occurs through microbial degradation. Both the shrimp and the water column exhibited similar PCP concentrations, which suggests that the shrimp did not accumulate PCP through the benthic food chain. Once the source of PCP contamination was removed, no persistance was observed in water or sediment, indicating no long term effects to the ecosystem. (Adams-PTT)
W86-05832

SALINITY, CHLORIDE, AND DENSITY RELATIONSHIPS IN ION ENRICHED ONONDAGA LAKE, NY,

Upstate Freshwater Inst., Inc., Syracuse, NY.
S. W. Effler, K. Schimel, and F. J. Millero.
Water, Air, and Soil Pollution, Vol. 27, No. 1-2, p 169-180, January 1986, 2 fig, 5 tab, 21 ref. NSF grant OCE 8120659.

Descriptors: *Salinity, *Chlorine, *Density, Physical properties, New York, Onodaga Lake, Lakes, Ion transport, Pollution, Stratification, Density stratification.

The relationship between salinity (S), chlorinity (Cl) and density (d) for the ion polluted (S=3 to 4.5 per thousand) and stratified Onondaga Lake are presented. The data base includes 220 determinations of the major ionic components collected from ten equally spaced depths. The salinity (S) and ionic strength (I) in the lake can be estimated from S= 1.85 Cl-0.28 where Cl is in g kg to the (-1) power and I=1.456(Cl (-))- 0.039, where (Cl) is in mmol L to the (-1) power. Due to the high concentration of Ca (2+) in the lake, the seawater equation of state could not be used to estimate reliable densities of the lake. A reliable equation of state for Onondaga Lake was derived from the composition data. The high ionic content of the lake depresses the temperature of maximum density to 3.18 degrees and alters the stratification of the lake. The salinity component of the stratification represents 41% of the total density stratification. (Masters-PTT)
W86-05841

MOSSBAUER STUDIES OF THE SPECIATION OF TRIBUTYLTIN COMPOUNDS IN SEAWATER AND SEDIMENT SAMPLES,

District of Columbia Univ., Washington. Dept. of Chemistry.
G. Eng, O. Bathersfield, and L. May.
Water, Air, and Soil Pollution, Vol. 27, No. 1-2, p

191-197, January 1986, 2 fig, 2 tab, 10 ref.

Descriptors: *Water pollution, *Heavy metals, *Organometallic pesticides, *Seawater, *Tributyltin compounds, Aerobic conditions, Anaerobic conditions, Sediments, Marine sediments, Antifoulant agents.

The antifoulant agents, bis-(tributyltin) oxide (TBTO), tributyltin acetate (TBTOAc) and tributyltin chloride (TBTCl) were mixed with distilled water and seawater and the Mossbauer spectra of their chloroform extracts were examined. The compounds were also mixed with aerobic and anaerobic sediments, and the Mossbauer spectra of the sediments examined. TBTO was converted to the hydroxide compound in all media except in anaerobic sediment where it was converted to an unidentified compound. TBTOAc and TBTCl were not changed by mixing with distilled water and aerobic sediment but were converted to the hydroxide compound in seawater and in anaerobic sediment. (Master-PTT)
W86-05842

CYANATRYN: DEGRADATION AND EFFECTIVENESS IN CONTROLLING AQUATIC PLANTS,

BASF Canada, Inc., Toronto (Ontario).
D. MacKenzie, G. J. Sirons, and R. Frank.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 35, No. 5, p 666-672, November 1985, 3 tab, 4 ref.

Descriptors: *Cyanatryn, *Aquatic plants, *Herbicides, *Aquatic weed control, Algal blooms, Ontario, Dissolved oxygen, Sediment.

Many ponds and small lakes in Ontario that were free of aquatic vegetation two decates ago are now covered with dense mats of algal blooms, and associated submersed and emerged aquatic plants. These plant growths have been promoted by increased nutrient levels and especially those nutrients that were limiting in the past. Under a provincial approved aquatic nuisance control permit, herbicides have been field tested to provide short term measures for controlling excessive plant growth. One herbicide tested under this program was cyantryn which was used to treat three small ponds. At treatment levels of 50-150 microgram/L, cyanatryn showed excellent efficiency in controlling vascular macrophytes within 14 to 28 days. However, this caused a problem with pond management because adequate dissolved oxygen (DO) levels could not be sustained and recovery to 2.5 ppm DO took at least 60 days. More research is needed on the persistence of cyanatryn and its impact on the total aquatic ecosystem. (Jones-PTT)
W86-05850

PERSISTENCE AND MUTAGENIC POTENTIAL OF HERBICIDE-DERIVED ANILINE RESIDUES IN POND WATER,

Cook Coll., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
C. D. Lyons, S. E. Katz, and R. Bartha.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 5, p 696-703, November 1985, 1 fig, 3 tab, 14 ref.

Descriptors: *Ponds, *Mutagens, *Herbicides, *Aniline, Biodegradation, Runoff, Agricultural runoff, Sludge, Kinetics, Fate of pollutants.

Herbicides that contain aniline or substituted aniline moieties are biodegraded with the eventual release of the anilines. The fate of herbicide-derived anilines in aquatic environments, which the herbicides may contaminate due to drift or runoff, was investigated. The persistence of aniline, 3-chloroaniline (3-CA), 4-chloroaniline (4-CA), 3,4-dichloroaniline (3,4-DCA), 2,6-diethylaniline (2,6-DEA) and 2,6-dinitro-4-trifluoromethylaniline (2,6-DNTFA) were compared in pond water and pond water with a sewage sludge inoculum as models of unpolluted and sewage-polluted fresh-water environments. The kinetics of removal for the biodegradable compounds and the mutagenic potential of the anilines and their biodegradation intermediates were also explored. It was found that biological removal of aniline can occur over a relatively wide concentration range. The high persistence of the substituted, compared to unsubstituted, compared to unsubstituted, anilines in pond water was unexpected. The main pathway of aniline degradation involves a dioxygenase attach resulting in catechol. (Jones-PTT)
W86-05851

226RA AND 228RA IN WATER SUPPLIES,

Argonne National Lab., IL. Radiological and Environmental Research Div.
For primary bibliographic entry see Field 5A.
W86-05869

EFFECT OF ATMOSPHERIC POLLUTION ON THE OUTFLOW AND ACCUMULATION OF HEAVY METALS IN THE DRAINAGE BASINS OF THE NIEPOLOMICE FOREST (SOUTHERN POLAND),

Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Reczynska-Dutka.
Acta Hydrobiologica, Vol. 27, No. 1, p 3-16, 1985. 2 fig, 5 tab, 30 ref.

Descriptors: *Air pollution, *Air pollution effects, *Heavy metals, *Catchment areas, *Poland, Runoff, Atmospheric deposition, Precipitation, Forest watersheds.

The high level of atmospheric pollution of the Niepolomice Forest led to a greater transport of certain metals from the forest watersheds into the stream waters. In spite of this, and with the atmospheric loading of 1 sq km of the forest, outputs of Pb, Cd, Cu, Ni, Zn, and Fe in the water was less than 33%. On the other hand, the export of Mn from both of the examined drainage basins increased, being on the average 75% for the Traczowka stream and as much as 296% for the Smigne. The main runoff occurred during periods of raised water levels, and was a consequence of the washing-out of the metals by rain or their release from snow. (Doria-PTT)
W86-05889

LIQUID-PHASE MASS TRANSFER COEFFICIENTS FOR SURFACE IMPOUNDMENTS,

Arkansas Univ., Fayetteville.
For primary bibliographic entry see Field 5D.
W86-05900

GEOCHEMICAL CONTROL OF (H+) IN LAKES RECEIVING ACIDIC DEPOSITION,

Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 2H.
W86-05903

DECLINE IN LEAD TRANSPORT BY THE MISSISSIPPI RIVER,

Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
J. H. Trefry, S. Metz, R. P. Trocine, and T. A. Nelsen.
Science SCIEAS, Vol. 230, No. 4724, p 439-441, October 25, 1985. 4 fig, 14 ref.

Descriptors: *Mississippi River, *Water pollution sources, *Path of pollutants, *Lead, Heavy metals, Gulf of Mexico, Fate of Pollutants, River sediments, Suspended sediments.

Inputs of pollutant lead to the Gulf of Mexico from the Mississippi River have declined by about 40% within the past decade. This decrease has been determined from annual lead loads of the Mississippi River and from the lead record in Mississippi Delta sediments. The observed trend is consistent with reduced consumption of lead in gasoline in the United States. More than 90% of the riverborne lead is associated with suspended sediments. Most of this particle-bound lead is deposited within 50 kilometers of the river mouth and is not easily leached at pH values above 3. (Authors' Abstract)
W86-05906

SURFACE WATER CHEMISTRY IN THE ILWAS BASINS,

Cornell Univ., Ithaca, NY. Dept. of Natural Resources.
C. L. Schofield, J. N. Galloway, and G. R. Hendry.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 4, p 403-423, December 1985. 14 fig, 5 tab, 15 ref.

Descriptors: *Lakes, *Acid rain, *Acid lakes, Chemical properties, Acidity, Alkalinity, Surface-groundwater relations, Cations, Hydrogen ion concentration, Panther Lake, Sagamore Lake, Woods Lake, New York, Watersheds, Aluminum Bicarbonate, Chemical precipitation, Soil chemistry.

Alkalinity and pH differences observed between the three Integrated lake Watershed Acidification Study (ILWAS) lakes (Panther, Sagamore, and Woods lakes) are primarily a result of inherent watershed differences in base cation supply rates, relative to comparable strong acid input levels. The relatively high proportion of base rich groundwater input to Panther Lake results in high pH and alkalinity, while shallow interflow with excess strong acid and high Al levels dominates the Woods Lake basin. Temporal acidification occurs as a result of base cation dilution and increased strong acid anion levels. These marked changes in surface water chemistry are related to an upward shift in flow paths from ground water dominated base flow to shallow interflow during increased snowmelt discharge. HNO3 from the snowpack and soil nitrification may trigger acidification and Al mobilization. Woods Lake serves as a secondary sink for Al exported from the soils of the watershed, particularly during the summer months when increasing pH levels induce Al precipitation. Strong acid neutralization in the ILWAS basin appear to be a two-stage process, with initial Al mobilization in upper soil horizons followed by primary mineral dissolution and alkalinity production in deeper soil horizons. Separation of these processes in either time or space results in incomplete neutralization, acidification, and export of inorganic Al to surface waters. (Doria-PTT)
W86-05907

ILWAS MODEL: FORMULATION AND APPLICATION,

Tetra Tech, Inc., Lafayette, CA.
For primary bibliographic entry see Field 2K.
W86-05908

OXIDATION-INDUCED LEACHING OF SULPHATE AND CATIONS FROM ACID SULPHATE SOILS,

Helsinki Univ. (Finland). Dept. of Agricultural Chemistry.
For primary bibliographic entry see Field 2G.
W86-05909

ADSORPTION OF MERCURY COMPOUNDS BY TROPICAL SOILS,

Norges Landbrukshoegskole, Aas. Dept. of Soil Fertilization and Management.
For primary bibliographic entry see Field 2G.
W86-05911

CHLORIDE BUDGET FOR ONONDAGA LAKE, NEW YORK, U.S.A.,

Upstate Freshwater Inst., Inc., Syracuse, NY.
For primary bibliographic entry see Field 2H.
W86-05912

MERCURY POLLUTION OF EFFLUENT, AIR, AND SOIL NEAR A BATTERY FACTORY IN TANZANIA,

Norges Landbrukshoegskole, Aas. Dept. of Soil Fertilization and Management.
E. Semu, B. R. Singh, and A. R. Selmer-Olsen.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 1-2, p 141-146, January 1986. 2 fig, 1 tab, 17 ref.

Descriptors: *Environmental effects, *Mercury, *Tanzania, *Air pollution, Effluents, Batteries, Soil contamination, Industrial wastes, Chemical analysis, Fate of pollutants.

Effluent, air, and soil samples were collected near a battery factory in Dar es Salaam, Tanzania, where HgC12 is used to prevent mold growth. Studies were performed with these samples to explore the potential for pollution of the environment from industrial discharge of Hg. Flameless atomic absorption spectrophotometry was used for Hg determinations. The concentration of Hg in the effluent ranged from < 0.2 to 5.2 mg/l and the Hg concentration varied greatly within and among sampling days. Air contained a mean of 4.0 micrograms/cu m with little variation within and between sampling days. Soils near the factory contained high Hg levels, from 6.7 to 472 mg/kg in the immediate vicinity, the highest level being associated with the disposal of solid waste (defective batteries). Downwind the concentration of Hg decreased with increasing distance from the factory resulting in a soil concentration of 1.0 mg Hg/kg about 2 km away. Upwind the Hg concentration decreased drastically within a distance of 100 to 200 m. (Doria-PTT)
W86-05914

NOTE ON THE CHARACTERIZATION OF AN ESTUARINE MICROBIAL COMMUNITY ENRICHED WITH THE HERBICIDE FENURON,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
S. F. Minney, R. J. Parkes, and A. T. Bull.
Journal of Applied Bacteriology JABAA4, Vol. 59, No. 1, p 17-22, July 1985. 3 fig, 2 tab, 9 ref.

Descriptors: *Estuarine environment, *Herbicides, *Biodegradation, *Sediments, *Fenuron, *Microbial degradation, Aniline, Microorganisms, Degradation, Pesticides.

The effects of heterogeneous culture conditions on the degradation of a herbicidal formulation (Fenuron: 1,1 dimethyl-3-phenylurea) and its derivatives (phenylurea and aniline) by a microbial community isolated from an estuarine sediment were studied. A stable, five-membered estuarine microbial community was enriched in the presence of Fenuron, phenylurea, and aniline. At a dilution rate of 0.01 hr in the chemostat, partial aniline utilization occurred, and the rate increased with dilution rate. At the higher dilution rates, the phenylurea component also was utilized. At a dilution rate of 0.015/hr in a fluidized bed system, complete removal of both aniline and phenylurea occurred. There was no evidence of Fenuron degradation under any of the conditions examined. The results suggest that the use of heterogeneous systems is desirable if the study of xenobiotic degradation in the laboratory is to be useful for the prediction of the degradation of these compounds under the heterogeneous conditions which would be encountered in the natural environment. (Doria-PTT)
W86-05939

GAS CHROMATOGRAPHIC MICROMETHOD FOR TRACE DETERMINATIONS OF PHENOLS,

Oklahoma Univ., Norman. Environmental and Ground Water Inst.
For primary bibliographic entry see Field 5A.
W86-05945

SULFATE AND NITRATE CONCENTRATIONS FROM A SOUTH GREENLAND ICE CORE,

New Hampshire Univ., Durham. Dept. of Earth Sciences.
P. A. Mayewski, W. B. Lyons, M. J. Spencer, M. Twickler, and W. Dansgaard.
Science SCIEAS, 232(4753): 975-977, May, 1986. 2 fig, 22 ref.

Descriptors: *Air pollution, *Path of pollutants, *Acid rain, *Ice, *Chlorides, *Nitrates, Sulfates, Greenland, Oxygen isotopes, North America, Eurasia, Atmosphere, Deposition.

An ice core in south Greenland covering the period 1896 to 1984 was analyzed for oxygen isotopes and chloride, nitrate, and sulfate concentrations. In 1984, an electromechanically drilled core was recovered from a site 40 km southwest and upice from a previously drilled site in south Greenland. The site is believed to be free of any local contaminations and is located directly downwind from seasonally directed air masses that emanate from North America and Eurasia. The data show that the excess (nonsea-salt) sulfate concentrations has tripled since approximately 1955. The increases may be attributable to the deposition of these chemical species from air masses carrying North America and Eurasia anthropogenic emissions. (Peters-PTT)
W86-05949

SUMMIT SPURS ACID RAIN ACTION,

R. L. Stanfield.
National Journal, Vol. 18, No. 15, p 892-893, April, 1986.

Descriptors: *Acid rain, *Lakes, *Pollutants, *Pollution control, Canada, Senate, Congress, Coal, Nitrogen oxides, Hydrocarbons, Carbon monoxide, Forests, Auto emissions, Scrubbers, Toxic sludge.

The acid rain debate is blowing up again, stirred by President Reagan's tacit acknowledgement that the damage to lakes that the Canadians have been complaining about is a serious, man-made problem. Henry a Waxman is sponsoring an acid rain control measure that for the first time is likely to be approved by his House of Representatives subcommittee. Robert T. Stafford introduced far-reaching acid rain control legislation that will probably pass through his Senate committee. Many environmentalists are pleased. The administration has been reluctant to spend the funds already allocated for clean coal research and development: a $700 million Energy Department coal research program that most observers say is too broad and too long range to have an immediate impact on acid rain, and the three-year, $400 million clean coal technology program that Congress approved over Administration protests. The focus is broadening to include other pollutants, particularly nitrogen oxides, hydrocarbons and carbon monoxide, and to cover forests as well as lakes in many parts of the country. Stafford's new bill covers the entire country, several pollutants and auto emissions as well as industrial and power plant pollution. Scrubbers have been one of the most controversial aspects of the acid rain debate. They are required on many new power plants and they represent the one technology that is tried and proven and can be purchased off the shelf. However, they are very inexpensive to install on old power plants. In addition, they create a toxic sludge that is expensive and dangerous to dispose of. State pollution control officials prefer a more flexible approach. (Peters-PTT)
W86-05950

EXCEPTION THAT APPROVES THE RULE: FDF VARIANCES UNDER THE CLEAN WATER ACT,

For primary bibliographic entry see Field 6E.
W86-05952

SPILLAGE OVER AN INCLINED EMBANKMENT,

Norges Tekniske Hoegskole, Trondheim. Dept. of Physics and Mathematics.
For primary bibliographic entry see Field 2E.
W86-05968

POSSIBLE SEDIMENT SCAVENGING OF CHLORDANE AND CONTAMINATION OF THE AQUATIC BIOTA IN BELMONT LAKE, NEW YORK,

New York State Office of Public Health, Albany. Wadsworth Center for Labs. and Research.
L. W. Wood, P. A. Jones, and A. Richards.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 2, p 159-167, February 1986, 1 fig, 2 tab, 22 ref. EPA Grant S002260010.

Descriptors: *Water pollution sources, *Chlordane, *Aquatic Biota, *Belmont Lake, *New York, Sediment, Contamination, Organochlorines, Oligochaetes, Fish, Organic pesticides, Food chain, Groundwater pollution, Biomagnification.

A recreational lake, now choked with aquatic weeds, is contaminated with chlordane, a persistent organochlorine compound. Chlordane is undetectable in water samples but present in sediments and surrounding terrestrial areas. Another potential source is shallow groundwater which provides 70% of lake inflow. It is hypothesize that both physico-chemical and biomagnification mechanisms are responsible for significant contamination of fish. Scavenging of chlordane from groundwater inflows by sorptive partitioning to organic matter in the sediments may be the first step. This concentrate then would become available for biomagnification through the food web to fish. (McFarlane-PTT)
W86-05992

GAS CHROMATOGRAPHIC DETERMINATION OF ORGANOCHLORINE PESTICIDES; CONTAMINATION OF DICOFOL, FENSON, AND TETRADIFON IN FISH AND NATURAL WATERS OF A WET AREA BESIDE THE MEDITERRANEAN SEA,

Valencia Univ. (Spain). Dept. of Analytical Chemistry.
J. C. Barbera, F. J. Lopez, F. Hernandez, J. Medina, and A. Pastor.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 2, p 211-218, February 1986, 5 fig, 3 tab, 19 ref.

Descriptors: *Pesticides, *Water pollution sources, *Organochlorines, *Organic pesticides, *Fishkill, *Path of pollutants, Mediterranean Sea, Gas chromatography, Rainfall, Agricultural runoff.

A large fish kill of mullet (Mugil spp.) occurred near an agricultural area which had suffered a recent red-mite infestation. The pesticides, Dicofol, Fenson, and Tetradifon were detected in water and organisms from the affected zone. The concentrations of all three pesticides were higher in the viscera and muscles of the killed fish than in live fish from the same location. It is hypothesized that the cause of death was a large temporary increase in pesticide concentration in the environment that resulted from a brief heavy rainfall which carried the pollutants toward the sea. (McFarlane-PTT)
W86-05996

POTENTIAL FORMATION OF BROMOPHENOLS IN BARCELONA'S TAP WATER DUE TO DAILY SALT MINE DISCHARGES AND OCCASIONAL PHENOL SPILLS,

Sociedad General de Aguas de Barcelona (Spain).
For primary bibliographic entry see Field 5F.
W86-05997

EFFECTS OF SUSPENDED SOLIDS ON THE BIOTRANSFORMATION OF ACENAPHTHENE,

North Texas State Univ., Denton. Inst. of Applied Sciences.
W. S. Hall, T. J. Leslie, and K. L. Dickson.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 2, p 286-293, February 1986, 3 fig, 3 tab, 10 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Biotransformation, *Priority pollutants, *Acenapthene, *Suspended Solids, Microorganisms, Hydrocarbons, Physicochemical properties, Aquatic environment.

Biotransformation is a major fate process for many chemicals in aquatic environments but no generalizations can be made about the importance of suspended solids in altering the biotransformation rate of chemicals. The effects of different types and varying levels of suspended solids on the biotransformation rate of acenaphthene, a priority pollutant representative of polynuclear aromatic hydrocarbons commonly found in aquatic environments,

were determined. The study demonstrated that physico-chemical characteristics of suspended solids and/or microbes indigenous to different aquatic systems are factors influencing biotransformation of acenaphthene and possibly other polynuclear aromatic hydrocarbons. (McFarlane-PTT)
W86-05999

MERCURY IN PLANTS, SOIL, AND WATER FROM A CAUSTIC CHLORINE INDUSTRY,

Berhampur Univ. (India). Dept. of Botany.
B. P. Shaw, A. Sahu, and A. K. Panigrahy.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 2, p 299-305, February 1986, 1 fig, 2 tab, 11 ref.

Descriptors: *Water pollution sources, *Chlorine production, *Mercury, *Industrial wastes, *Water pollution, Plants, Soil, Effluents, India, Leaching, Air pollution, Rushikulya River, Estuaries, Mud, Rainfall.

The residual level of mercury in vegetaion and concentration in the effluent and solid waste of a caustic chlorine industry on the Rushikulya River estuary which discharges into the Bay of Bengal, India, was determined. Mercury is discharged through washings as effluent and sedimented mud or brine mud. Brine mud is occasionally removed and deposited in a nearby field subjecting it to aerial dispersion after drying, as well as rain leaching. Other sources of mercury discharge to the atmosphere are the ventilation air outlets from cell rooms and hydrogen gas outlets. Brine mud contained 597 mg/kg dry wt. Plants contained as much as 40 mg/kg, declining with increasing distance from the source. (McFarlane-PTT)
W86-06000

ECOLOGICAL CONSEQUENCE ASSESSMENT: EFFECTS OF BIOENGINEERED ORGANISMS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
J. Cairns, Jr., and J. R. Pratt.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 171-182, April 1986. 4 fig, 3 tab, 32 ref.

Descriptors: *Genetic engineering, *Ecosystem assessment, *Infection, *Bacteria, Microorganisms, Genetics, Conceptual models, Systems analysis, Mesocosms, Microcosms, Field tests, Prediction, Toxicity.

The introduction of genetically altered microorganisms into natural ecosystems presents fundamentally new problems in risk assessment and ecological effect evaluation. Novel microorganisms, produced by any of several new methods, have the ability to survive and reproduce in the environment. Since most of these organisms are bacteria, they have the potential to interfere with natural processes, displace natural populations, infect new hosts, move between ecosystems, and cause far-reaching ecological disturbances. Currently available methods in ecological research that might be used in evaluating the ecological effects of releasing genetically altered microorganisms are critically reviewed. Microcosm, mesocosm, and field tests should provide valuable predictions concerning the potential ecological impact of genetically altered organisms. Ecosystem assessments will also be useful in post-release such as those currently used to evaluate toxic impacts. The present problem does not require the development of new testing methods but rather the creation of adequate predictive models (both conceptual and systems-based) to predict the potential for adverse effect of genetically altered organisms. (Author's abstract)
W86-06011

TWO-DIMENSIONAL PARTICLE TRACKING ESTUARINE TRANSPORT MODEL,

Washington Univ., Seattle. Dept. of Civil Engineering.
W.-S. Chu, and S. Gardner.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 183-189, April 1986. 7 fig, 23 ref.

Descriptors: *Path of pollutants, *Hydrodynamic models, *Estuaries, *Particle tracking model, *Wastewater pollution, *Flushing, Mathematical models, Humboldt Bay, California, Pollutant transport, Shellfish, Water quality.

A two-dimensional particle tracking model was developed for estuarine water quality investigations requires only the solution of a two-dimensional hydrodynamics model and, therefore, is more economical to use than conventional multi-dimensional estuarine transport models. The present model does not consider turbulent diffusion, and it handles only conservative constituents. The model was applied to Humboldt Bay, California, where the flushing of sewage effluent was simulated. The model was applied to evaluate the present release plan, and to determine alternative release plans for limiting the transport of sewage effluent into shellfish producing areas within the Bay. The results showed that both the time of release and release duration are significant factors in the determination of the eventual fate of the effluent. By varying both the time and duration of the release, and alternative release scenario with the least impact on the mudflats of the Bay has been proposed. (Rochester-PTT)
W86-06012

SALINITY OF MOTORWAY SOILS. I. VARIATION IN TIME AND BETWEEN REGIONS IN THE SALINITY OF SOILS ON CENTRAL RESERVES,

Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
J. R. Thompson, A. J. Rutter, and P. S. Ridout.
Journal of Applied Ecology, Vol. 23, No. 1, p 251-267, 1986. 8 fig, 3 tab, 29 ref.

Descriptors: *Highway effects, *Water pollution sources, *Path of pollutants, *Soil chemistry, *Saline soils, *England, *Deicers, *Sodium chloride, Soil solution, Seasonal variation, Runoff.

The use of rock salt for de-icing in England and soil salinity along highways were investigated. Sodium chloride is used in England at rates varying from 2-20 tons per lane km. The severity of winter weather strongly influences the application rate, which varied from about 4 to about 13 t/lane km, as a mean over the whole country, between 1974 and 1979. Similar variations in average application rate occurred between northern and southern regions. Sodium concentration in the 0-50 mm layer of the soil of central reserves (median strips) fluctuated considerably. Maximum values, usually in January-March, were often several times the minima found in September and October. Soil sodium concentrations in April were correlated with salt usage rates during the previous winter and showed similar regional and altitudinal variability. In the 0-50 mm layer of soil, sodium levels varied from <500 microgram/g to several thousand microgram/g. Sodium was more persistent in the soil than chloride. In April the highest concentration of sodium, and often also of chloride, was found in the 0-50 mm layer of the soil profile. By October much of the sodium has been transported to greater depth, and much of the chloride had disappeared from the soil. Observations extending over 6 years suggested that there was no consistent annual increase in the salinity of the soils of central reserves. (See also W86-06034 through W86-06036) (Author's abstract)
W86-06033

SALINITY OF MOTORWAY SOILS. II. DISTANCE FROM THE CARRIAGEWAY AND OTHER SOURCES OF LOCAL VARIATION IN SALINITY,

Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
J. R. Thompson, A. J. Rutter, and P. S. Ridout.
Journal of Applied Ecology, Vol. 23, No. 1, p 269-280, 1986. 6 fig, 3 tab, 6 ref.

Descriptors: *Highways effects, *Water pollution sources, Path of pollutants, *England, *Saline soils, *Deicers, *Sodium chloride, *Verges, Soil solution, Traffic effects, Runoff.

The variation of soil sodium concentration with distance from the carriageway on central reserves (median strips) and verges was studied on a number of motorway sites in England. At further sites the interaction of the effects of distance with other aspects of motorway construction and management was investigated. On the standard 4 m-wide central reserve, soil sodium concentration at the center was usually 50-70% of the value 0.5 m from the carriageway, and curvature of the motorway had no detectable effect on this pattern. On central reserves exceeding 7 m in width, there was a zone at least 2 m wide in which sodium concentration was <70% of the value 0.5 m from the carriageway. In some wide (9-10 m) reserves concentration in the central zone was about 10% of that at the margins. The establishment of shrubs on central reserves increased the soil sodium concentration by about 50%. Provided there was a hard shoulder between verge and carriageway, the sodium concentration at 2 m from the margin of the verge was between 30% and 40% of that at the center of the central reserve. Beyond this distance, sodium concentrations on the verge were very low. There were effects on soil sodium levels related to the direction of the traffic or the orientation of the road that cannot be explained simply. (See also W86-06033, W86-06035, W86-06036) (Author's abstract)
W86-06034

SALINITY OF MOTORWAY SOILS. III. SIMULATION OF THE EFFECTS OF SALT USAGE AND RAINFALL ON SODIUM AND CHLORIDE CONCENTRATIONS IN THE SOIL OF CENTRAL RESERVES,

Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
A. J. Rutter, and J. R. Thompson.
Journal of Applied Ecology, Vol. 23, No. 1, p 281-297, 1986. 7 fig, 5 tab, 10 ref.

Descriptors: *Highways effects, *Water pollution sources, *Path of pollutants, *England, *Leaching, *Saline soils, *Deicers, Sodium, Chloride, *Simulation, Soil solution, Mathematical models, Rainfall, Runoff.

Transfer to the central reserve (median strip) of salt applied to motorway carriageways and the leaching of sodium and chloride ions from the soil of the reserve are described by a mathematical model. The model was developed and elaborated until it gave a satisfactory fit to data from nine English sites. Given daily rainfall and monthly totals of salt application and potential evaporation, the model calculates the change of sodium and chloride concentrations with time and depth in soil. Values of the transfer and leaching coefficients giving best fit to long runs of data varied from site to site, but for each coefficient extreme values were within + or - 50% of the mean. Mean values of these coefficients were used in calculations of expected concentrations of sodium and chloride in soil 0-250 mm deep on 31 March at 12 sites distributed through the motorway system and over 3 yr. There were significant relations between observed and calculated concentrations at these sites. Standard deviations of observed values from calculated values were about + or - 250 microgram/gram for sodium and + or - 100 microgram/gram for chloride. (See also W86-06033, W86-06034, W86-06036) (Author's abstract)
W86-06035

SALINITY OF MOTORWAY SOILS. IV. EFFECTS OF SODIUM CHLORIDE ON SOME NATIVE BRITISH SHRUB SPECIES, AND THE POSSIBILITY OF ESTABLISHING SHRUBS ON THE CENTRAL RESERVES OF MOTORWAYS,

Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
J. R. Thompson, and A. J. Rutter.
Journal of Applied Ecology, Vol. 23, No. 1, p 299-315, 1986. 4 fig, 6 tab, 27 ref.

Descriptors: *Highways, *Shrubs, *Water pollution effects, *Saline soils, *Salt tolerance, *Deicers, England, Sodium, Chlorides, Soil solution.

Individuals of 11 native British shrub species (Prunus spinosa L., Cornus sanguinea L., Hippophae rhamnoides L., Viburnum opulus L., Acer campestre L., Rosa rubiginosa L., Salix viminalis L., Viburnum lantana L., Salix caprea L., Salix cinerea L. x viminalis L., Crataegus monogyna Jacq.) grown outdoors in containers were subjected to NaCl solutions of different concentrations, either periodically sprayed onto the plants, or added to the soil, through two successive winters (1977-79). Salt solutions added to the soil produced concentrations per unit dry weight of soil of up to 2,500 microgram Na/gram and 1,500 microgram Cl/gram by the start of the growing season. In general, solutions added to the soil had greater effects than the same solutions sprayed onto the plants. There was considerable difference among species in the concentrations in the soil that caused a given mortality or reduction in growth. Susceptibility to salt spray damage was not closely correlated with susceptibility to salt damage via the soil. From a knowledge of sodium and chloride concentrations in the soil it is concluded that in the southern half of England many species of shrub could be grown in the central reserves (median strips) of motorways, but that few could be grown in this situation in the north, and probably none in the extreme northeast. Circumstantial evidence to support this conclusion is reviewed. (See also W86-06033 through W86-06035) (Author's abstract)
W86-06036

SOURCES AND TRANSPORT OF ORGANOCHLORINE COMPOUNDS AND HEAVY METALS INTO WATERS OF THE NATIONAL PARK OF DONANA,

Consejo Superior de Investigaciones Cientificas, Madrid (Spain). Inst. de Quimica Organica General.
G. Baluja, J. Gonzalez, C. Rico, and L. M. Hernandez.
Bulletin of Environmental Contamination and Toxicology BECTAG, Vol. 35, No. 4, p 482-489, October 1985. 5 fig, 16 ref.

Descriptors: *Organochlorine pesticides, *Path of pollutants, *Heavy metals, Spain, Water transport, Atomic absorption, Pesticides, Polychlorinated biphenyls, Mercury, Cadmium, Lead, Copper, Zinc, Air pollution, Mine drainage, Rainfall, Lagoons, Channels, Streams, Shallow water.

The pollution by organochlorine pesticides, PCBs, and heavy metals of abiotic material and plants and fauna of the biological reserve of the National Park of Donana have been reported. The current study was designed to see if hexaclorocyclohexanes (HCHs), total DDTs and PCBs, and mercury, cadmium, lead, copper and zinc were being transported into the water system of the park, and to elucidate the sources of these pollutants. Water sampling was made on surface waters from lagoons, channels and streams. Preanalytical treatment of samples and the analysis of organochlorine compounds by GLC-EC were carried out. Mercury was analyzed by flameless atomic absorption. Lead, cadmium, copper and zinc were analyzed by flame atomic absorption. Duplicate analyses were made and recoveries of organochlorine residues were in a range of 90-95%, 87-99% for Hg, Pb and Cu, nd 87% for Zn. Most of the results of the organochlorine tests fluctuated in a small range around the mean line, which suggests a rather homogeneous distribution of residues. The occurance of pesticides in a shallow water lagoon indicates airborne dispersion of organochlorine residues. An extremely high concentration of metals was found in a sample close to a mine. The highest metal concentrations in water were Pb, Cu and Zn. A clear relationship between the rainfall and the metal load was not found. Heavy metals along the stream flow are distributed homogeneously. The aquatic system of the park is polluted by low levels of organochlorine pesticides and PCBs, as well as significant levels of Hg, Cd, Pb, Cu and Zn, but a gradient in the concentration range in any direction following the predominant stream flow inside the marsh was not observed. (Main-PTT)
W86-06069

FATE OF 2,4-D ENTERING A FRESHWATER AQUATIC ENVIRONMENT,

Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
R. D. DeLaune, and L. M. Salinas.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 4, p 564-568, October 1985. 3 fig, 8 ref.

Descriptors: *2,4-D, *Organic pesticides, *Path of pollutants, *Lakes, *Sediments, *Biodegredation, Louisiana, Oxidation-reduction potential, Adsorption, Aerobic conditions, Anaerobic conditions, Water hyacinth, Lake sediments, Fate of pollutants.

Large quantities of 2,4-D (2,4-dichlorophenoxyacetic acid) are being used for water hyacinth control in Louisiana. There is insufficient scientific information available to determine the fate of 2,4-D as a result of its intensive use as an aquatic herbicide. Sediment was collected from two Louisiana shallow freshwater lakes. Sufficient surface water was added to each sediment sample to produce a water-to-sediment ratio of 8:1. The sediment suspensions were equilibrated. The redox potential was monitored by a platinum electrode-calomel half cell and a millivolt meter. Two redox potentials, one strongly reducing and the other oxidizing were used. Labelled 2,4-D at a concentration of 5 micro g/g was added to each flask. A series of sediment water columns was sampled to determine the rate at which 2,4-D was adsorbed from the overlying water into the sediment. Degradation of 2,4-D was approximately six times faster under aerobic conditions compared to anaerobic conditions for sediment. Degradation in the water was slower compared to degradation in the sediment. Labeled 2,4-D was rapidly adsorbed from the water column into the sediment. The 2,4-D that diffuses deeper into the sediment profile, where anaerobic conditions occur, will be slower to degrade. (Main-PTT)
W86-06074

ENVIRONMENTAL MOVEMENT OF INDICATOR BACTERIA FROM SOIL AMENDED WITH UNDIGESTED SEWAGE SLUDGE,

Oklahoma Univ. Health Sciences Center, Oklahoma City.
D. D. Ibiebele, and A. D. Inyang.
Environmental Pollution (Series A) EPEBD7, Vol. 40, No. 1, p. 53-62, January 1986. 2 fig, 3 tab, 5 ref.

Descriptors: *Sludge utilization, *Soil amendments, *Bioindicators, *Streptococcus, *Path of pollutants, Sludge disposal, Coliforms.

Application of sewage sludge to agricultural land can be an innovative alternative to the traditional sludge management methods. Land application of undigested sludge not only provides moisture for irrigation and the addition of high levels of crop nutrients while improving soil texture and stability, but it also reduces solids handling, as required in conventional sludge treatment facilities. Despite these benefits, the paucity of background information on the microbiological safety of sludge may have prevented the widespread use of undigested sludge on agricultural land. Therefore, it is important to investigate the relationship between the quantity of sludge applied to soil, and the number of indicator bacteria, namely, coliform or faecal streptococci organisms, transported into the subsoil, the ground water, or to the skin, leaves or sap of maize and tomato plants. Although studies indicate an obvious contamination, there is also a gradual decline. Agricultural activities such as cultivation and harvesting, and environmental factors such as wind, birds, and insects, may be the principal agents transporting bacteria from sludge-amended soils to the plants. Other environmental factors such as high temperature, humidity, rainfall and sunlight may be responsible for bacterial decline. (David-PTT)
W86-06083

INDUSTRY REPORT,

For primary bibliographic entry see Field 5G.
W86-06086

STATISTICAL ANALYSIS OF HEAVY METAL CONCENTRATIONS FROM LAKE SEDIMENTS,

Texas A and M Univ., College Station. Center for Trace Characterization.
V. O. Ogugbuaja.
Journal of Environmental Science Health (A) JESEDU, Vol. A20, No. 5, p. 529-554, July 1985. 2 fig, 13 tab, 17 ref.

Descriptors: *Path of pollutants, *Powerplant wastes, *Heavy metals, *Lake sediments, *Sediment concentration, Houston, Texas, Industrial wastes, Computer programs, Data interpretation, Iron, Manganese, Cadmium, Copper, Zinc, Organic matter, Graphical analysis, Statistical analysis.

A large amount of data was acquired during a study of heavy metal concentration in aqueous sediments in an area surrounding W.A. Parish coal fired power plant in southwest Houston. Because of the amount of data, detailed interpretations and correlations of certain factors became difficult. Therefore, a statisical analysis technique that could reduce the data and make information about the data readily apparent was needed. Statistical Analysis System (SAS) computer packages were considered, because they were found to be rather powerful in the analysis of data in other fields. SAS is a computer software system for data analysis that provides tools for data modification and programming, and for statistical analysis. In the analysis of data obtained from the study of sediments from lakes around a coal-fired plant, the SAS Computer packages proved to be useful and suitable. The large data accumulated were subjected to clustering techniques. Tree diagrams -- dendrograms -- and K-means cluster were plotted from the reduced clusterdata set to highlight the (dis)similarity pattern of metals among the lakes. Also presented were the correlations between the scavenging parameters -- Fe, Mn, clay material and organic matter -- and the metals Cd, Cu, and Zn. Furthermore, relationships between depth from surface and the metals at this initial time of study, were assessed. (David-PTT)
W86-06088

FERTILIZATION MANAGEMENT OF CROPS IRRIGATED WITH SALINE WATER,

Agricultural Research Organization, Bet-Dagan (Israel). Inst. of Soils and Water.
For primary bibliographic entry see Field 3C.
W86-06089

CADMIUM SOIL SORPTION AT LOW CONCENTRATIONS. IV. EFFECT OF WASTE LEACHATES ON DISTRIBUTION COEFFICIENTS,

Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
T. H. Christensen.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 3, p 265-274, November 1985. 6 fig, 2 tab, 6 ref.

Descriptors: *Cadmium, *Path of pollutants, *Soil properties, *Sorption, *Leachates, *Environmental effects, *Distribution coefficients, Kinetics, Waste disposal, Sand, Loam, Hydrogen ion concentration, Soil contamination.

Sorption, onto two mineral soils, of Cd present at low concentrations in unpolluted soil solutions and waste leachates (compost, incinerator slag, sewage slag) were examined by laboratory batch experiments in terms of kinetics, equilbrium distributions, isotherms and the effect of pH. From an environmental point of view, sorption of Cd from waste leachates is a fast process (equilibrium within 2 hr) although slightly slower than from unpolluted soil solution. Both soils (sand, sandy loam) exhibited approximately linear sorption isotherms for all solutes. The slope of the isotherms, the Cd distribution coefficient, was 30 to 250 times smaller from waste leachates than from unpolluted soil solutions, indicating a much increased mobility of Cd in waste leachates. The effect of pH on the Cd distribution coefficients was less consistent in waste leachates, than in unpolluted soil solution, varying form hardly any effect to a 7 fold increase

for a pH increase of approximately one unit. (Main-PTT)
W86-06090

INTEGRATED LAKE-WATERSHED ACIDIFICATION STUDY: SUMMARY,

Electric Power Research Inst., Palo Alto, CA. Environmental Assessment Dept.
R. A. Goldstein, C. W. Chen, and S. A. Gherini.
Water, Air, and Soil Pollution, Vol. 26, No. 4, p 327-337, December 1985. 5 fig, 1 tab, 17 ref.

Descriptors: *Acid rain, *Lake watersheds, *Acidification, Forested watersheds, New York, Adirondack Park, Surface water, Mathematical simulation models.

An integrated, interdisciplinary, intensive study of three forested watersheds in the Adirondack Park region of New York State was started in 1977 to quantify the relationship between the deposition of atmospheric acids and surface water acidity. A general mechanistic theory of lake-watershed acidification that takes into account the production and consumption of acidity by watershed processes, as well as atmospheric input of acidity, was developed. Ths theory is formulated as a mathematical simulation model. Model and data analyses establish the importance of using an integrated ecosystem perspective to assess the vulnerability of surface waters to acidification by acidic deposition. The acid-base status of surface waters is determined by the interaction of many factors: soil, hydrologic, vegetation, geologic, climatic, atmospheric. The absolute and relative contribution of any given factor can be highly variable, both geographically and temporally; hence, lake sensitivity to changes in the quality and quantity of atmospheric deposition is also highly variable. (Author's abstract)
W86-06092

INTEGRATED LAKE-WATERSHED ACIDIFICATION STUDY: ATMOSPHERIC INPUTS,

Oklahoma State Univ., Stillwater. School of Chemical Engineering.
A. H. Johannes, E. R. Altwicker, and N. L. Clesceri.
Water, Air, and Soil Pollution, Vol. 26, No. 4, p 339-353, December 1985. 10 fig, 3 tab, 12 ref.

Descriptors: *Acid rain, *Lake watersheds acidification, New York, Precipitation, Ion loadings, Trees, Acidic deposition, Surface waters, Adirondack Mountains, ILWAS.

Integrated Lake-Watershed Acidificaton Study (ILWAS) was initiated in late 1977 to quantify the relationship between acidic deposition and the acidity of surface waters. The main objective of this element of the ILWAS project was to quantify wet and dry deposition, throughfall chemistry, and ambient air quality, and to determine whether the three lake-watersheds did in fact receive similar atmospheric inputs. Atmospheric inputs to Woods, Panther, and Sagamore Lake-Watersheds in the Adirondack Mountains were measured on a daily basis from March 1978 through December 1981. Precipitation quality was nearly identical at all sites on monthly and yearly bases; ion loadings to each watershed were principally controlled by the amount of precipitation. No yearly trend was evident for any ion concentration in wet deposition. Annual precipitation quantities showed little deviation from long-term averages for this region. Throughfall measured under various species of trees showed enrichment in most base cations and acid anions. Deciduous trees were found to increase the pH of incident precipitation, while coniferous canopies tended to decrease pH. (Main-PTT)
W86-06093

BIOGEOCHEMICAL INFLUENCE OF VEGETATION AND SOILS IN THE ILWAS WATERSHEDS,

Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
C. S. Cronan.
Water, Air, and Soil Pollution, Vol. 26, No. 4, p 355-371, December 1985. 3 fig, 8 tab, 19 ref.

Descriptors: *Acid rain, *Lakes, *ILWAS watershed, *Soils, New York, Trees, Surface waters, Nitrate, Sulfate, Organic acidity, Soil horizons, Till strata, Adirondacks.

The ILWAS catchments contain closely related variants of the northern hardwood-spruce-fir complex of the Adirondack Region. On an areal basis, the watersheds contain 57 to 88% hardwood cover type and range in percent coniferous cover from 28% in Sagamore watershed to 5% in Woods catchment. Mean live basal area values range from 22 to 30 sq m/ha between catchments, while mean live stem densities range from 1400 to 1700 stems/ha. Weighted average leaf area indices for the watersheds range from a low of 5.2 in Woods to a high of 7.2 in Sagamore. The higher leaf area in Sagamore watershed may enhance the collection of dry deposition and may explain the higher sulfate concentrations in surface waters within that system. The soils in the ILWAS are characterized by a low percent base saturation, exhibit pH values ranging from 2.9 in the forest floor to 4.7 in the BC horizon, and contain relatively low concentrations of soluble and adsorbed sulfate. Sulfate is the dominant solution anion in upper soil layers in all three watersheds and in the lake waters of Woods and Sagamore basins. However, nitrate concentrations are also high in soil solutions. Levels of organic acidity are elevated in surface horizon solutions and decline significantly with soil depth. In general, soil water chemistries in the Woods and Panther catchments are almost indistinguishable. Thus, the differences in lake pH and akalinity cannot be explained on the basis of inter-watershed contrasts in soil chemistry and soil solution chemistry. Much of the explanation can be related to inter-watershed differences in hydrologic flow paths, coupled with distinct differences in solution chemistry between separate soil horizons and till strata. (Main-PTT)
W86-06094

CHEMICAL TRANSPORT FACILITATED BY MULTIPHASE FLOW SYSTEMS,

Robert S. Kerr Environmental Research Lab., Ada, OK.
C. G. Enfield.
Water Science and Technology WSTED4, Vol. 17, No. 9, p 1-12, September 1985. 1 fig, 18 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Chemical transport, *Multiphase flow systems, Sorption, Transport properties, Chemical transformation, Miscible displacement, Immiscible displacement, Mathematical studies, Fate of pollutants.

Evaluation of the potential for contamination of soils and ground waters by land treatment and disposal of chemicals requires a screening approach which can be utilized by individuals in regulatory offices. The approaches in common usage often appear to underestimate the mobility of relatively immobile chemicals that have been observed moving significantly faster than anticipated from hydrophobic theory. A theory is developed considering transport in three mobile fluid phases which can be used to describe this facilitated transport. The convective dispersive transport equation is solved utlizing a transformation of variables which permits utilizing existing solutions covering a wide variety of boundary conditions. The impact of the facilitated tranpsort is demonstrated for one case where the soils organic carbon is 10%. If 2% of the fluid phase is an organic fraction, the theory developed projects that hydrophobic theory may underestimate mobility by more than 100 times. At concentrations of dissolved organic carbon normally observed in nature (5-10 microgram/L), a measurable increased mobility is anticipated for the very immobile compounds like dioxins. (Main-PTT)
W86-06095

CIRCULATION INDUCED BY COASTAL DIFFUSER DISCHARGE,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
E. E. Adams, and J. H. Trowbridge.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 111, No. 6, p 973-984, November 1985, 7 fig, 2 tab, 12 ref.

Descriptors: *Path of pollutants, *Thermal pollution, *Waste heat, *Powerplants, Discharge measurement, Coastal powerplants, Nearshore entrainment, Heal transfer.

Submerged multiport diffusers are often used to discharge waste heat resulting from once-through cooling at coastal power plants. A particularly effective design, known as a stage diffuser, involves nozzles oriented off-shore, parallel with the diffuser pipe. Potential flow analyses are used to describe the far field entrainment region for a staged diffuser discharging to quiescent receiving water of either constant depth or linear sloping bottom. Boundary conditions, in the form of a distributed sink, are supplied by a simplified near field model. Whereas near field theory shows that dilution can be increased by increasing discharge velocity, extending diffuser length or siting in deeper water, the latter options are shown to be preferable from the standpoint of minimizing induced velocities and the magnitude of nearshore entrainment. (Author's abstract)
W86-06114

CADMIUM AND NICKEL IN MAINSTREAM PARTICULATES OF CIGARETTES CONTAINING TOBACCO GROWN ON A LOW-CADMIUM SOIL-SLUDGE MIXTURE,

New York State Coll. of Agriculture and Life Sciences, Ithaca.
C. A. Bache, D. J. Lisk, G. J. Doss, D. Hoffmann, and J. D. Adams.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 16, No. 3/4, p 547-552, April 1985. 3 tab, 17 ref.

Descriptors: *Cadmium, *Path of pollutants, *Nickel, *Sludge disposal, Heavy metals, Particulate matter, *Tobacco, Soil contamination, Pollution effects.

Cigarettes were prepared from tobaccos grown in a greenhouse on a soil to which a low rate of a municipal sewage sludge was applied. The cigarettes were smoked by machine and a mainstream particulate fraction was analyzed for total cadmium and nickel content. Sludge-grown and control (soil-grown) tobaccos contained, respectively, 5.33 and 1.87 ppm of cadmium and 1.15 and 0.64 ppm of nickel. The average quantities of cadmium and nickel (ng/cigarette) found in the mainstream particulate fractions were, respectively, 220.5 and 78.5 for the sludge-grown and 147.4 and 72.6 for the control treatments. The difference between treatments was highly significant ($p<0.001$) for cadmium but not for nickel. (Author's abstract)
W86-06119

BIOLOGICAL AVAILABILITY OF NICKEL ARSENIDES: CELLULAR RESPONSE TO SOLUBLE NI5AS2,

Los Alamos National Lab., NM.
L. R. Gurley, J. G. Valdez, J. J. Miglio, S. H. Cox, and R. A. Tobey.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 17, No. 2, p 101-117, January 1986. 8 fig, 25 ref.

Descriptors: *Path of pollutants, *Oil shale wastes, *Nickel, *Arsenic compounds, *Solubility, Bioassay, *Heavy metals, Toxicity, Carcinogens, Groundwater pollution, Oil shale.

Particulate nickel arsenide is highly cytotoxic and carcinogenic. If produced during oil-shale retorting, it could be mobilized to the environment and made available to the cells of living organisms, including humans. Nickel arsenide was five times more soluble in ground water taken from aquifers surrounding a major oil-shale source in Colorado than in distilled water. It was also two times more soluble in oil-shale product water from an aboveground retort than in distilled water. Thus it is possible than nickel arsenide could be solubilized

and mobilized to the environment by the flooding of abandoned in-situ retorts with ground water or by the disposal of oil-shale product water by spraying it on spent shale beds. Particulate nickel arsenide was 12 times more soluble in culture growth medium than in distilled water, and much more soluble in solutions of amino acids, inorganic salts, organic constituents of culture medium, and 15% calf serum. These observations suggest nickel arsenide particles in airborne dust would be dissolved when they came in contact with the biological fluids of the lung and gastrointestinal tract. Nickel arsenide carcinogenesis might be caused by epigenetic rather than mutagenic mechanisms. (Authors' abstract)
W86-06120

ARTIFICIAL-SUBSTRATUM PERIPHYTON AND WATER QUALITY IN THE LOWER LA TROBE RIVER, VICTORIA,

Latrobe Valley Water and Sewage Board, Traralgon (Australia).
B. C. Chessman.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 36, No. 6, p 855-871, December 1985. 12 fig, 4 tab, 46 ref.

Descriptors: *Water quality, *Diatoms, Organic carbon, Chlorophyll A, Thermal pollution, Dissolved solids, Snails, Australia.

Between February 1975 and March 1977, periphyton from artificial substrata (glass microscope slides) and water samples for physicochemical analysis were obtained from eight sites on the lowland section of the La Trobe River (Australia), which flows through agricultural, urban and industrial areas. Total organic matter on the slides, estimated as weight loss on ignition, was usually highest in summer or autumn when river flows were low, However, chlorophyll A densities generally peaked in late winter and spring when nitrate concentrations were high, except at a site upstream of major urban and industrial areas, where a summer-autumn increase occurred. Thermal discharges from power stations had no obvious effect on chlorophyll abundance, but did appear to substantially influence diatom assemblage composition from late summer to early winter, when river temperatures were highest. Downstream of the Morwell River confluence, diaton assemblages were influenced by a sharp increase in dissolved solids concentration and probably also by the grazing activities of snails. The diatom flora at the most downstream site showed some evidence of recovery from thermal effects. (Author's abstract)
W86-06127

ESTIMATES OF ECOSYSTEM METABOLISM IN THE LA TROBE RIVER, VICTORIA,

Latrobe Valley Water and Sewage Board, Traralgon (Australia).
B. C. Chessman.
Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 36, No. 6, p 873-880, December 1985. 2 fig, 3 tab, 21 ref.

Descriptors: *Ecology, *Ecosystems, *Metabolism, Productivity, Respiration, Benthos, Plankton, Nutrients, Australia.

Diel oxygen-curve techniques were used to estimate gross primary productivity, community respiration and net daily metabolism for five reaches of the La Trobe River from headwaters to lowlands. All reaches were heterotrophic throughout the study (December 1980 to November 1981). Net daily metabolism ranged from -1 to -6 grams of oxygen per square meter. Gross primary productivity was consistently very low at the most upstream station and highest in the middle reaches of the river, where both benthic and planktonic contributions were important. At the most downstream station benthic productivity was negligible but planktonic productivity was appreciable in the spring and autumn. Gross primary productivity in the river may be limited in the upper reaches by lack of light (due to shading by vegetation) and low levels of nutrients, and in the lower reaches by turbidity and increased depth. (Author's abstract)
W86-06128

SOIL SORPTION OF ORGANIC VAPORS AND EFFECTS OF HUMIDITY ON SORPTIVE MECHANISM AND CAPACITY,

Geological Survey, Denver, CO.
C. T. Chiou, and T. D. Shoup.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1196-1200, December 1985. 7 fig, 1 tab, 19 ref.

Descriptors: *Path of pollutants, *Sorption, *Soil water, Relative humidity, Organic solvents.

Vapor sorption isotherms on dry Woodburn soil at 20-30 degrees Celcius were determined for benzene, chlorobenzene, p-dichlorobenzene, m-dichlorobenzene, 1,2,4-trichlorobenzene, and water as single vapors and for benzene, m-dichlorobenzene, and 1,2,4-trichlorobenzene as functions of relative humidity. Isotherms for all compounds on dry soil samples are distinctly nonlinear, with water showing the greatest capacity. Water vapor sharply reduced the sorption capacities of organic compounds with the dry soil; on water-saturated soil, the reduction was about 2 orders of magnitude. The markedly higher sorption of organic vapors at subsaturation humidities is attributed to adsorption on the mineral matter, which predominates over the simultaneous uptake by partition into the organic matter. At about 90% relative humidity, the sorption capacities of organic compounds become comparable to those in aqueous systems. The effect of humidity is attributed to adsorptive displacement by water of organics adsorbed on the mineral matter. A small residual uptake is attributed to the partition into the soil-organic phase that has been postulated in aqueous systems. The results are essentially in keeping with the model that was previously proposed for sorption on the soil from water and from organic solvents. (Author's abstract)
W86-06138

EVIDENCE THAT FILTERABLE PHOSPHOROUS IS A SIGNIFICANT ATMOSPHERIC LINK IN THE PHOSPHOROUS CYCLE,

Colorado Univ. at Boulder. Dept. of Environmental, Population, and Organismic Biology.
For primary bibliographic entry see Field 2H.
W86-06143

RATE AND PATHWAYS OF PHOSPHOROUS ASSIMILATION IN THE NEPEAN RIVER AT CAMDEN, NEW SOUTH WALES,

New South Wales Inst. of Tech., Broadway (Australia). School of Biological and Biomedical Sciences.
B. L. Simmons, and D. M. H. Cheng.
Water Research WATRAG, Vol. 19, No. 9, p 1089-1095, 1985. 6 fig, 4 tab, 14 ref.

Descriptors: *Assimilative capacity, *Phosphorus removal, *Phosphorus, *Fate of pollutants, *Path of pollutants, Suspended solids, Nutrient removal, Phytoplankton, Sedimentation, Nutrients, Wastewater facilities, Rivers, Models, Filtration, Littoral zone, Australia.

The Nepean River receives effluent containing phosphorus from a sewage treatment plant at Camden, N.S.W. Phosphorus concentration, suspended solids, sediments and aquatic plants downstream of the outfall, were examined to determine the rate and pathways of phosphorus loss from the waterway. The phosphorus added was found to follow first order kinetics in its removal from the waterway. Two reaction pathways were discernible with over 90% of the added phosphorus being removed from the water column in 11 days, and the remainder in a further 70 days. The process remained constant from summer to winter and could be modelled for dry weather flows representing 68% of river flows. Soluble phosphorus was first incorporated into particles before being removed from the water column. Evidence is presented to show that the particles were predominantly phytoplankton and they were largely removed from the water column by littoral zone filtration. The second pathway appears to be sedimentation of nutrient laden particles. (Author's abstract)
W86-06149

IN SITU SEDIMENT OXYGEN DEMAND DETERMINATIONS IN THE PASSAIC RIVER (NJ) DURING THE LATE SUMMER/EARLY FALL 1983,

Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
C. G. Uchrin, and W. K. Ahlert.
Water Research WATRAG, Vol. 19, No. 9, p 1141-1144, 1895. 3 fig, 2 tab, 19 ref. D-07524-2-84.

Descriptors: *Oxygen demand, *Biological oxygen demand, *Dissolved oxygen, *Rivers, *Fluvial sediments, Bottom sediments, Water pollution effects, Oxygen uptake, Temperature effects, Water pollution sources, Water quality, Fate of pollutants, New Jersey.

In situ sediment oxygen demand (SOD) rate determinations were performed on the freshwater Passaic River system during the late summer/early fall of 1983. Values obtained ranged from non-detectable to 2.43 g/sq m/day. The SOD value obtained just after the Whippany River confluence was non-detectable while historical values at that point were as high as 12.8 g/sq m/day. The value obtained at Paterson was not significantly different than historical values while the low value obtained at Two Bridges may be indicative of temperature effects. The dependency of the SOD rate on temperature was observed in consonance with the observations of other investigators performing laboratory experiments. (Geiger-PTT)
W86-06155

GEOCHEMICAL FACTORS COMPLICATING THE USE OF AUFWUCHS TO MONITOR BIOACCUMULATION OF ARSENIC, CADMIUM, CHROMIUM, COPPER AND ZINC,

Savannah River Ecology Lab., Aiken, SC.
M. C. Newman, J. J. Alberts, and V. A. Greenhut.
Water Research WATRAG, Vol. 19, No. 9, p 1157-1165, 1985. 3 fig, 5 tab, 27 ref. DOE grant No. EY-76-C-09-0819.

Descriptors: *Monitoring, *Bioaccumulation, *Bioindicators, *Heavy metals, *Trace elements, *Aquatic life, Arsenic, Cadmium, Chromium, Copper, Zinc, Manganese, Iron, Error analysis, Settling basins, Powerplants, Aquatic environments, Geochemistry, Fate of pollutants.

Material accumulating on submerged glass slides (aufwuchs) was sampled from five sites associated with coal ash settling basins and from one control site to examine factors complicating the use of aufwuchs to monitor the bioaccumulation of heavy metals. Correlation analyses showed a strong, positive correlation between the five elements As, Cd, Cr, Cu and Zn and concentrations of associated Fe or Mn. Negative, weak or nonsignificant correlations were observed between the concentrations of these five metals and microfloral cell densities or per cent ash free weight of the material. Scanning electron microscopy and X ray analyses demonstrated that the majority of the material was abiotic and the elemental levels associated with the abiotic components were generally higher than those of the biotic components. Hydrous Fe and Mn oxides likely play dominant roles in determining the trace element concentrations in these procedurally-defined aufwuchs. These results show the potential for misinterpretation of biomonitoring data employing procedurally-defined aufwuchs. (Geiger-PTT)
W86-06157

DISSOLVED ORGANIC CARBON OF COAL SLURRY TRANSPORT WATER,

Tennessee Univ., Knoxville. Dept. of Microbiology.
M. C. Reid, J. W. Davis, G. S. Sayler, and R. A. Minear.
Water Research, Vol. 19, No. 9, p 1199-1203, 1985. 3 fig, 3 tab, 16 ref. DOI grant No. 14-34-0001-1455.

Descriptors: *Fate of pollutants, *Organic carbon, *Leaching, *Mine wastes, *Pipelines, Wastewater, Coal mines, Biochemical oxygen demands, Wastewater analysis, Slurries, Water pollution effects, Bioassays, Public health.

The qualitative and quantitative occurrence and fate of dissolved organic carbon (DOC) leaching into coal slurry transport water was examined in laboratory-generated coal slurries and wastewaters from the Black Mesa coal slurry pipeline. Laboratory slurries were formulated for both western coals (Wyodak, Montana Rosebud, and Black Mesa) and eastern coals (Illinois No. 6 and Pittsburgh No. 8). Sephadex G-25 elution profiles and ultrafiltration studies indicate that the majority of the organic compounds in western coal slurry wastewaters were lower (less than 1000) molecular weight species (62% for Wyodak and 74% for Montana Rosebud). Biochemical Oxygen Demand (BOD) for these particular wastewaters ranged from 50 to 150 mg/liter as determined through the use of an electrolytic respirometer. Also, there was a concomitant 51-74% reduction in the DOC levels in the wastewaters. This removal was primarily due to the removal of the lower (<1000) molecular weight compounds by the seed inoculum. There was no evidence for the presence of mutagenic organics in the raw wastewater. (Author's abstract)
W86-06162

PATHS OF THE SUSPENDED PARTICULATE INORGANIC AND ORGANIC MATTER IN A SMALL URBAN ESTUARY. THE AARHUS HARBOUR ESTUARY,

Aarhus Univ. (Denmark). Lab. of Geomorphology.
K. B. Kronvang, and C. Christiansen.
Nordic Hydrology, Vol. 17, No. 1, p 31-46, 1986. 11 fig, 2 tab, 26 ref.

Descriptors: *Aarhus Harbor Estuary, *Suspended load, *Path of pollutants, *Urban areas, *Estuaries, Organic matter, Inorganic compounds, Suspended sediments, Dredging, Zones, Heavy metals, Denmark.

The sediment budget for the Aarhus Harbor Estuary, Denmark, indicated that the estuary acted as a sink for river introduced inorganic (1920000 kg/y) and organic (1200000 kg/y) particulate matter. One fifth of the import escaped to the Aarhus Bay. There was an agreement between the dredged sediment quantity in the harbor and the mass to sedimentation from the budget. The estuary was divided into three depositional zones: 1) Upper estuary: a zone of high accumulation, small median particle size, and high organic content; 2) Central estuary: a zone of medium to high accumulation, large median particle size, high rate of resuspension and medium organic content; and 3) Lower estuary: a zone of low accumulation (increasing toward winter), small median particle size and low organic content. Dredging for harbor maintenance should be more concentrated on the upper estuary and done before the season with high river discharge. This would not only reduce the costs of keeping the harbor dredged, but also make it easier to keep track of the heavy metals in the sediments. (Lantz-PTT)
W86-06165

GROUND-WATER RECHARGE AND ITS EFFECTS ON NITRATE CONCENTRATION BENEATH A MANURED FIELD SITE IN PENNSYLVANIA,

Geological Survey, Towson, MD. Water Resources Div.
J. M. Gerhart.
Ground Water GRWAAP, Vol. 24, No. 4, p 483-489, July-August 1986. 12 fig, 4 ref.

Descriptors: *Groundwater recharge, *Nitrates, *Water pollution sources, *Path of pollutants, *Pennsylvania, *Manure, Agricultural runoff, Lancaster County, Bedrock, Geologic fractures, Nitrogen, Storms, Rainfall infiltration, Recharge.

Groundwater recharge to a shallow, unconfined, fractured dolomite aquifer underlying agricultural land in Lancaster County, Pennsylvania occurs by two mechanisms. Direct recharge occurs through pathways such as near-surface bedrock fractures and sinkholes, and affects the dissolved nitrate concentration of groundwater within two to three days, with its effects lasting only about one week.

Gradual recharge occurs through small channels and pores in the unsaturated zone and affects dissolved nitrate concentrations for several weeks or more after the effects of direct recharge have dissipated. Whether recharge causes an increase or decrease in dissolved nitrate concentration depends on the amount of nitrogen-rich manure spread on the site prior to the storm. Direct recharge from a storm on the site prior to the storm. Direct recharge from a storm in March 1984, a month in which 18 tons of manure were spread, resulted in a rapid decrease in the dissolved nitrate concentration of about 2.5 milligrams/L (mg/L) as nitrogen. Direct recharge from a storm in May 1984, after 384 tons of manure had been spread in April, resulted in a rapid increase in dissolved nitrate concentration of about 3 mg/L as nitrogen. Concentration changes caused by gradual recharge several weeks or more after the storms were of the same magnitude as those caused by direct recharge during the storm. (Author's abstract)
W86-06172

5C. Effects Of Pollution

RESPONSE OF THE MICROFLORA IN OUTDOOR EXPERIMENTAL STREAMS TO PENTACHLOROPHENOL: ENVIRONMENTAL FACTORS,

Minnesota Univ., Navarre. Gray Freshwater Biological Inst.
J. J. Pignatello, L. K. Johnson, M. M. Martinson, R. E. Carlson, and R. L. Crawford.
Canadian Journal of Microbiology CJMIAZ, Vol. 32, No. 1, p 38-46, January 1986. 6 fig, 2 tab, 27 ref. EPA Contract CR-810016-01-1.

Descriptors: *Fate oı pollutants, *Path of pollutants, *Experimental streams, *Pentachlorophenol, *Water pollution effects, Flora, Microenvironment, Environmental effects, Microbial degradation, Aerobic digestion, Anaerobic digestion, Biodegradation, Sediments, Seasonal variation, Temperature effects.

The second year of a 2-year study on the fate of pentachlorophenol in outdoor artificial streams focused on details of microbial degradation by a combination of in situ and laboratory measurements. Replicate streams were dosed continuously at pentachlorophenol concentrations of 0, 48, and 144 micrograms/L, respectively, for an 88-d period during the summer of 1983. Pentachlorophenol was degraded both aerobically and anaerobically, with aerobic degradation more rapid than anaerobic degradation. Mineralization of pentachlorophenol was concommitant with pentachlorophenol disappearance under aerobic conditions, but lagged behind loss of the parent molecule under anaerobic conditions. Biodegradation in streams, or in specific stream compartments, was characterized by an adaptation period (3-5 weeks for the stream as a whole), which was inversely dependent on the concentration of pentachlorophenol and microbial biomass. The adaptation in the streams could be attributed to the time necessary for selective enrichment of an initially low population of pentachlorophenol degraders on surface compartments. The extent of biodegradation in the streams increased with increasing pentechlorophenol input, explicable by an increase in the pentachlorophenol degrader population with increasing pentachlorophenol concentration. The sediment zone most significant to overall pentachlorophenol biodegradation was the top 0.5- to 1-cm layer, as shown by pentachlorophenol migration rates and depth profiles of degrader density within the sediment. Pentachlorophenol profiles in sediment cores taken during and after the adaptation period for degradation showed that diffusion of pentachlorophenol into the sediment was rate limiting to degradation in this compartment. Degradation rates were independent of temperature within the temperature range of the streams during the dosing season (19-30 C), but became increasingly slower below 19 C. The impact of sudden increases in toxicant level (to 10 or 100 mg/L) on degradation was significant (negative), and was assessed by laboratory experiments with sediments. (Lantz-PTT)
W86-05418

MERCURY RESISTANT BACTERIA ISOLATED FROM SEDIMENT,

Guelph Univ. (Ontario). Dept. of Environmental Biology.
J. T. Trevors.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 3, p 405-411, March 1986. 5 fig, 11 ref.

Descriptors: *River sediments, *Path of pollutants, *Mercury resistant bacteria, *Plasmids, *Bacteria, Genetic code, Speed River, Ontario, Canada, Aeromonas hydrophila, Pseudomonas mendocina, Citrobacter freundii, Mercuric chloride, Agarose gel electrophoresis, Deoxyribonucleic acid, Bacterial physiology.

Mercury-resistant bacteria were isolated from samples of the surface 10 cm of sediment from the Speed River, Ontario (Canada) and agarose gel electrophoresis was employed to isolate plasmids. The mercury-resistant bacteria found were tentatively identified as: Aeromonas hydrophila, Pseudomonas sp, Pseudomonas mendocina, and Citrobacter freudii. A. hydrophila contained 5 plasmids, P mendocina, 4, C freundii, 5, and the Pseudomonas sp, 2. No common plasmids (in size or numbers) were present in the four mercury-resistant isolates. At concentrations of 100 micromolar, HgCl2 did not reduce significantly the growth rates or final cell yields in cultures of three of the species, but did delay onset of the logarithmic growth phase by 8 hr in Pseudomonas sp. Plasmid curing experiments with sublethal concentrations of ethidium bromide did not yield any HgCl2-sensitive derivatives. It is therefore unknown which of the plasmids controlling mercury resistance is plasmid-encoded. (Rochester-PTT)
W86-05481

METABOLITES OF XENOBIOTICS IN THE BILE OF FISH IN WATERWAYS POLLUTED BY PULPMILL EFFLUENTS,

Joensuu Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 5B.
W86-05482

EVALUATION OF METABOLIC RESPONSES OF ARTEMIA SALINA TO OIL AND OIL DISPERSANT AS A POTENTIAL INDICATOR OF TOXICANT STRESS,

Athens Univ. (Greece). Dept. of Zoology.
G. Verriopoulos, M. Moraitou-Apostolopoulou, and A. Xatzispirou.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 3, p 444-451, March 1986. 2 fig, 1 tab, 17 ref.

Descriptors: *Oil, *Shrimp, *Bioassay, *Bioindicators, *Oil dispersants, Respiration, Toxicity, Artemia salina, Stress, Metabolism.

The effects of Tunisian crude oil, zarzaitine type, the oil dispersant Finasol-OSR2, and their mixture, on repiration of brine shrimp were determined in synthetic sea water. Four groups of test animals were used: large males (8-10 mm long), medium males (6-8 mm), large females (8-10 mm), and medium females (6-8 mm). The LC50's for various experiment runs were as follows: oil, 300, 440, and 500 ppm; Finasol, 1, 10, and 20 ppm; and oil + Finasol, 1 ppm. All three solutions elicited changes in respiration rate (expressed as a percentage of the control values). The direction of change (stimulation or suppression) was the same for the three solutions, and appeared to be concentration-dependent. There was a general trend of decreasing respiration rate at below and up to the LC50 (48 hr) concentration. At higher concentrations, an inportant stimulation of respiration was observed. At the highest tested concentrations, respiration was suppressed significantly. In most cases an important respiratory change was apparent at very low toxicant concentrations (1/40 to 1/15 of the 48-hr LC50). The direction of the respiratory rate change was not always the same as the one observed at higher concentrations and up to the LC50 concentration. (Rochester-PTT)
W86-05484

ACID PHOSPHATASE ACTIVITY IN THE INTESTINE AND CAECA OF BLUEGILL, EXPOSED TO METHYL MERCURIC CHLORIDE,

Kent State Univ., OH. Dept. of Biological Sciences.
A. Hossain, and H. M. Dutta.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 3, p 460-467, March 1986. 4 fig, 1 tab, 18 ref.

Descriptors: *Acid phosphatase, *Water pollution effects, *Path of pollutants, *Enzyme activity, *Bluegill, *Methylmercury, *Metabolism, *Mercuric chloride, Toxins, Morphology, Intestine, Digestion, Caeca, Animal physiology.

Changes in acid phosphatase activity in different regions of the intestine and intestinal diverticulae of bluegill fish (Lepomis macrochirus) were measured because these enzymes are highly sensitive to methyl mercury. In both control and mercury-exposed (3.4 x 10(-12) M methyl mercuric chloride in aquarium water) fish, the first part of the intestine (INT1) exhibited higher enzyme activity compared to the other parts. In both groups the intestinal caeca showed lower activity compared to that of the intestine. A common trend of gradual increase in phosphatase activity from 24 to 72 hr was observed in all parts of the intestine in exposed fish. Besides this trend of increased activity in exposed fish, the increase was unusually high in the anal part (INT4). The relatively higher activity of acid phosphatase in INT1 and the heterogeneity of activity in the remaining parts of the intestine may be explained by variations in morphology and functions among the different intestinal regions as well as the different rates in the flow of food-stuff within the intestine. High activity in INT4 of the exposed fish may be due to direct contact of the anal region with the Hg-contaminated water. (Rochester-PTT)
W86-05486

VARIABLE SENSITIVITY OF RAINBOW TROUT (SALMO GAIRDNERI) EGGS AND ALEVINS TO HEAVY METALS,

University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
N. A. M. Shazili, and D. Pascoe.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 3, p 468-474, March 1986. 3 tab, 20 ref.

Descriptors: *Water pollution effects, *Toxic wastes, *Cadmium, *Copper, *Zinc, *Toxicity, *Eggs, *Alevins, *Rainbow trout, Heavy metals, Embryonic growth stage, Mortality.

The toxicity of cadmium, copper, and zinc to rainbow trout was examined at six different emryonic and two alevin stages of development. The 48-hr LC50, obtained from toxicity curves relating median lethal time (LT50) and test concentration, was employed to permit comparison of sensitivities of the different stages. The blastodisc stage, 5 days post-fertilization under the conditions used, was markedly more resistant to all three metals than any other development stage. This was followed by an increase in sensitivity. In the case of Cd and Zn, the stage at which the embyonic axis becomes clear (10 days) was the most sensitive, but with Cu, sensitivity increased throughout embryonic development. The next major change occurred after hatching when, with both Cd and Zn, alevins were more sensitive than eggs immediately prior to hatch. With Cu there was no change. The difference in sensitivity to copper, compared to Cd and Zn, suggests that Cu may have a different target tissue or mode of action. (Rochester-PTT)
W86-05487

EFFECTS OF PH ON THE ACUTE TOXICITY AND UPTAKE OF (14C) PENTACHLOROPHENOL IN THE MIDGE, CHIRONOMUS RIPARIUS,

Ohio State Univ., Columbus. Dept. of Entomology.
S. W. Fisher, and R. W. Wadleigh.
Ecotoxicology and Environmental Safety, Vol. 11, No. 1, p 1-8, February 1986. 4 fig, 2 tab, 21 ref.

Descriptors: *Water pollution effects, *Hydrogen ion concentration, *Pentachlorophenol, *Midges, *Toxicity, Bioassay, Lipophilicity, Protonation, Isotope studies, Chironomus riparius, Carbon-14, Chemical properties.

The acute toxicity of pentachlorophenol (PCP) was determined at pH levels 4, 6, and 9 to the midge Chironomus riparius. PCP showed the greatest toxicity at pH 4 and the least at pH 9. This differential toxicity is attributable to variations in uptake levels at the respective pH levels. At pH 4, PCP is fully protonated and therefore highly lipophilic. The amount of (14C)PCP present in the midges at 24 hr is thus highest at pH 4. Conversely, at pH 9, PCP is completely ionized. The reduction in lipophilicity at pH 9 decreases the ability of the compound to penetrate into the midge, thereby decreasing the observed toxicity. (Author's abstract)
W86-05488

EFFECTS OF METAL SALT MIXTURES ON DAPHNIA MAGNA REPRODUCTION,

Environmental Research Lab.-Duluth, MN.
K. E. Biesinger, G. M. Christensen, and J. T. Fiandt.
Ecotoxicology and Environmental Safety, Vol. 11, No. 1, p 9-14, February 1986. 3 fig, 1 tab, 14 ref.

Descriptors: *Water pollution effects, *Cadmium, *Mercury, *Zinc, *Daphnia magna, *Reproduction, Heavy metals, Synergistic effects, Toxins, Complete block design, Bioassay.

Three binary metal experiments were conducted using a 'complete block design,' testing the chlorides of Cd, Hg, and Zn individually and the combinations Cd-Hg, Cd-Zn, and Zn-Hg on Daphnia magna reproduction. These mixtures were tested at one-half, once, and twice the 16% reproductive-impairment concentration previously determined for the individual metals. The Cd-Hg, Cd-Zn, and Zn-Hg mixtures all showed significant reductions in reproduction at concentrations where the metal salts alone showed no significant effect. The results indicate that mixtures combined at 'no effect' concentrations for individual toxicants still exert toxic action in chronic and acute tests and suggest that water quality criteria and standards based on these endpoints may not be adequate to protect some aquatic species when mixtures of toxicants are present. (Rochester-PTT)
W86-05489

EARLY LIFE-STAGE TOXICITY TEST METHODS FOR GULF TOADFISH (OPSANUS BETA) AND RESULTS USING CHLORPYRIFOS,

For primary bibliographic entry see Field 5A.
W86-05490

TOLERANCE TO CADMIUM AND CADMIUM-BINDING IN GREAT SALT LAKE BRINE SHRIMP (ARTEMIA SALINA),

Utah State Univ., Logan.
S. Jayesekara, D. B. Drown, and R. P. Sharma.
Ecotoxicology and Environmental Safety ECOLAR, Vol. 11, No. 1, p 23-30, February 1986. 3 fig, 3 tab, 14 ref.

Descriptors: *Cadmium, *Toxic wastes, *Water pollution effects, *Path of pollutants, *Brine Shrimp, *Great Salt Lake, Uptake, Gel filtration, Atomic absorption spectrometry, Chromatography, Utah, Bioaccumulation, Ultraviolet absorption, Proteins, Heavy metals, Cytosol, Metabolism, Tolerance mechanisms.

Information on the accumulation of Cd in cytosolic proteins of Great Salt Lake (Utah) brine shrimp was obtained from animals collected directly in the lake and from animals hatched and maintained in three sublethal concentrations of Cd (0.5, 2.0, and 5.0 ppm) im saltwater aquaria. Heat-stable, Cd-binding ligands were isolated and identified by Sephandex G-75 chromatography and atomic absorption spectorophotometry. cadmium was equally distributed between high and low molecular weight proteins in animals collected from the lake anmd the 0.5 ppm Cd group. There was a slight growth stimulation noted in the 0.5-ppm group. Higher Cd incorporation was noted in low molecular weight fractions with increasing Cd concentration in the exposure media. Low molecular weight fractions also had higher UV absorption at 280 nm. Molecular weight of the nanometer (nm) and low absorption at 280 nm. Molecular weight of the Cd-binding ligands was 11,000, as estimated by the gel filtration method. De novo synthesis of this protein was increased as a function of Cd concentration in the media. However, slow accumulation of Cd in other protein fractions also was noticed in higher Cd exposure groups, suggesting the existence of possible tolerance mechanisms in brine shrimp exposed to suspected acute Cd concentrations. This protein is similar to metallothionein described in other mammals and aquatic organisms. Although metallothioneins have a role in the detoxification of metals, the high tolerance of brine shrimp cannot be adequately explained by the induction of cadmium-binding protein alone. (Rochester-PTT)
W86-05491

HISTOLOGICAL AND BIOCHEMICAL EFFECTS OF CADMIUM EXPOSURE IN THE BLUEGILL SUNFISH (LEPOMIS MACROCHIRUS),

Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
D. J. Versteeg, and J. P. Geisy.
Ecotoxicology and Environmenmtal Safety ECOLAR, Vol. 11, No. 1, p 31-43, February 1986. 6 fig, 3 tab, 44 ref.

Descriptors: *Water pollution effects, *Toxic wastes, *Bluegill sunfish, *Cadmium, *Toxicity, *Mortality, Gills, Serum acid phosphatase, Serum aspartate transaminase, Serum alanine transaminase, Lactate dehydrogenase, Liver lysosomes, N-acetyl-beta-D-glucosaminidase, Lysosomal membranes, Bioassay, Lepomis macrochirus, Chronic exposure, Subchronic exposure, Growth, Survival, Histopathology, Enzyme activity.

Growth and survival of the bluegill sunfish were monitored and tissues were removed for histopathological assessment of the toxicant effects of Cd in a 163-day chronic exposure. The biochemical effects of Cd were determined by a 32-day subchronic exposure. Exposure of fish in hard water (363 mg Ca/L) caused significant reductions in growth at 3.9 and 12.7 mg Cd/L. Histopathological lesions were observed in gill tissue from fish exposed to 3.9 and 12.7 mg Cd/L at all times during the chronic exposure. no histopathological lesions were observed in any internal organ during this exposure. In 32-day subchronic exposure, Cd caused significant increases in serum acid phosphatase and N-acetyl-beta-D-glucosaminidase activities. Serum aspartate and alanine transaminase and lactate dehydrogenase activities were not increased by Cd exposure. this indicates an alteration in lysosome function. Thus Cd-induced tissue damage was biochemically detected during an exposure regime which failed to produce histopathological effects on internal organs. The biochemical effects appear to be due to Cd-induced damage to liver, spleen, or intestine and changes in cellular autophagy. (Rochester-PTT)
W86-05492

EFFECTS OF PH ON THE ENVIRONMENTAL FATE OF (14C) ALDICARB IN AN AQUATIC MICROCOSM,

Ohio State Univ., Columbus.
For primary bibliographic entry see Field 5B.
W86-05493

IN VITRO CYTOTOXICITY TESTING OF AQUATIC POLLUTANTS (CADMIUM, COPPER, ZINC, NICKEL) USING ESTABLISHED FISH CELL LINES,

Rockefeller Univ., New York. Lab. Animal Research Center.
For primary bibliographic entry see Field 5A.
W86-05494

Group 5C—Effects Of Pollution

FIELD EVIDENCE FOR AN ACID RAIN EFFECT ON LICHENS,

Sheffield Univ. (England). Dept. of Landscape Architecture.
O. L. Gilbert.
Environmental Pollution (Series A) EPEBD7, Vol. 40, No. 3, p 227-231, 1986. 13 ref.

Descriptors: *Lichens, *Water pollution effects, *Acid rain, Oak trees, Ash trees, Blue-green algae, Bark acidification, Plant pathology, Buffering.

Field evidence for an acid rain effect on lichens at two sites in northern England is presented. Well-established populations of Lobaria pulmonaria on oak and Dticta limbata on ash trees in remote rural areas were observed to decline to the point of extinction. This was accompanied by bark acidification. Only lichens containing a blue-green algal component (Nostoc) and growing in habitats poorly buffered on the acid side were affected. The most likely mechanism by which acid rain could eliminate these two lichens is through the effect of low pH on nitrogen fixation by NOSTOC. The evidence suggests that the increase in rainfall acidity is damaging rich areas of epophytic lichen vegetation in the United Kingdom. (Rochester-PTT)
W86-05511

LEAD CONCENTRATIONS IN BULLFROG RANA CATESBEIANA AND GREEN FROG R. CLAMITANS TADPOLES INHABITING HIGHWAY DRAINAGES,

Patuxent Wildlife Research Center, Laurel, MD.
For primary bibliographic entry see Field 5B.
W86-05512

ENGINEERING AND NUTRITIONAL PARAMETERS AFFECTING BIOFILM DEVELOPMENT,

Mara Inst. of Tech., Selangor (Malaysia). School of Applied Science.
N. Shariff, and R. S. Hassan.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 12, p 423-425, December 1985. 5 fig, 22 ref.

Descriptors: *Biofilm, Cooling towers, Microbial film, Nutrients.

The development of biofilm on glass slides with inocula obtained from an air conditioning cooling tower was studied using biofilm reactors of eight one-liter beakers with attached stirrers. Excess water was drained from the slide for one minute and the biofilm thickness was obtained by the difference in the distance travelled by the 10X objective lens when focused on the glass slide and the biofilm surface. The results generally showed poor development of biofilm. Enriching the cooling tower medium encouraged better biofilm development. The addition of glucose also increased the microbial film thickness and rate of formation. A shorter retention time promoted biofilm development. At 33 C, good biofilm development was observed. Sloughing of biofilm increased with increasing biofilm thickness and turbulence. Nutrient and engineering parameters do influence biofilm development. (Main-PTT)
W86-05526

ACUTE TOXICITY OF PENTACHLOROPHENOL TO THE FRESHWATER SNAIL, GILLIA ALTILIS,

Boston Univ., MA.
R. J. Stuart, and J. B. Robertson.
Bulletin of Environmental Contamination and Toxicology BECTAG, Vol. 35, No. 5, p 633-640, November 1985. 4 fig, 1 tab, 11 ref.

Descriptors: *Pesticides, *Pentachlorophenol, *Snails, *Bioindicators, *Toxicity, *Water pollution effects, Lethal limits, Survival, Bioaccumulation, Ecological effects.

Over 80 million pounds of pentachlorophenol (PCP) are produced each year, making it one of the most heavily used pesticides in the United States. The chemical can easily find its way into aquatic ecosystems. Since the PCP that reaches aquatic environments can be photolysized, the toxicity of the photodegradation products were examined. The technical formulation is one used by industry, allowing the toxicity of the mixture to be examined and compared with pure PCP, to determine whether it is a parent compound, or one of the accompanying impurities, that is responsible for any observed toxicity. Snails were exposed to PCP concentrations from 0 to 200 micro M. Following a four hour exposure period, snails were rinsed, transferred to containers of dechlorinated water,and monitored for 7 days. This procedure was repeated for 96 hour exposure, with a dose range from 0 to 10 micro M. A dynamic 96-hr test was also performed at concentrations of 0.8, 1.0, and 1.5 micro M. In addition, a 4-hr exposure was performed in the dark, and technical grade PCP was compared to pure PCP, also using a four hour exposure. The LC50 value obtained for snails collected in the fall was 100 micro M PCP, which was four times as great as the spring valve of 24 micro M PCP. In the static 96-hr test, the LC50 value obtained was 3 micro M (0.81 milligrams/L) for he pure PCP. The dynamic 96-hr test had an LC50 of 1.1 micro M PCP (0.3 micrograms/L). This increased toxicity appears to be due to the change of PCP solutions every 24 hrs. The LC50 for the 4-hr exposure was 100 micro M in laboratory light, but only 70 micro M for exposures in the dark. Results indicate that this species of snail could be used as a biological monitor for PCP pollution in rivers and streams. (Main-PTT)
W86-05534

ALDICARB SULFOXIDE/ALDICARB SULFONE MIXTURE IN DRINKING WATER OF RATS: EFFECTS ON GROWTH AND ACETYLCHOLINESTERASE ACTIVITY,

Mellon Inst.-Union Carbide Corp., Export, PA. Bushy Run Research Center.
L. R. DePass, E. V. Weaer, and E. J. Mirro.
Journal of Toxicology and Environmental Health JTEHD6, Vol. 2, p 163-172, August, 1985. 4 tab, 11 ref.

Descriptors: *Aldicarb sulfoxide/aldicarb sulfone, *Drinking water, Water pollution effects, *Rats, *Growth, *Acetylcholinesterase, Toxicity, Potable water, Pesticides, Tissue analysis, Chemical analysis.

In spite of the large toxicology data base, no studies have been reported on the toxicity of aldicarb residues in the drinking water. This represents a possible route of human exposure, since trace residues of aldicarb metabolites have been found in potable water resulting from subsurface agricultural application to shallow groundwater sources. A 1:1 mixture of aldicarb sulfoxide/aldicarb sulfone was administered to young adult Wistar rats via the drinking water at nominal concentrations of 19.2, 4.8, 1.2, 0.3, 0.075, or 0 ppm for 29 d. Blood was collected after 8, 15, and 29 d of treatment for plasma and erythrocyte cholinesterase determinations, and brain cholinesterase was determined at sacrifice. Body weight gain and water consumption were reduced at 7, 14, 21, and 29 d but was reduced in females only on day 7. Both plasma and erythrocyte cholinesterase activity was reduced after 8, 15, and 29 d in male and female rats at 19.2 ppm. Males at 4.8 ppm showed reductions in plasma activity only after d 8 and in erythrocyte activity only after d 29. Female rats at 19.2 ppm also displayed depressions in brain cholinesterase activity not observed in similarly treated males. Since the only effects noted at 4.8 ppm were reductions in plasma and red blood cell cholinesterase activity in males only and at only one of three sampling periods, these two instances are not believed to be of any biological significance. The data suggest the 4.8 ppm in drinking water is a no observable ill-effect level for exposure of rats to aldicarb residues based on the parameters measured in this study. (Main-PTT)
W86-05537

TROPHIC STATUS OF 19 SUBARCTIC LAKES IN THE YUKON TERRITORY,

Department of Fisheries and Oceans, Vancouver (British Columbia). Fisheries Research Branch.
K. S. Shortreed, and J. G. Stockner.
Canadian Journal of Fisheries and Aquatic Science CJFSBX, Vol. 43, No. 3, p 797-805, March 1986. 7 fig, 5 tab, 44 ref.

Descriptors: *Yukon territory, *Limnology, *Subarctic lakes, *Trophic level, *Phosphorous, *Nitrogen, *Chlorophyll, *Bacterioplankton, *Carbon, Phytoplankton production, Synechococcus sp, Cyclops scutifer, Daphnia spp, Diaptomus pribilofensis, Canada, Regression analysis.

Limnological investigations were carried out on 19 Yukon River Basin (Canada) lakes in the summer of 1982 and on 10 of the lakes in March of 1983. Their surface areas ranged from 1.6 to 90 sq km and mean depths from 2.5 to 93 m. Regression analyses were carried out using various chemical and biological variables and results were compared with similar studies in other geographical areas. Based on range in total phosphorus concentrations (3.2-12.9 micrograms/liter), average chlorophyll levels (0.62-3.76 micrograms/liter), and average bacterioplankton numbers (7.8 x 10(5) to > 10 (7) per ml), most lakes were oligotropic, several were mesotrophic, and one was close to eutrophy. Particulate concentrations of P, N, and C indicated that most lakes were predominately P-limited, but in a number, N was also important in limiting phytoplankton production. The picoplankter Synechococcus sp was the most abundant phytoplankton species, and common zooplankters were Cyclops scutifer, Daphnia spp., and Diaptomus pribilofensis. (Author's Abstract)
W86-05559

INTERVENTION ANALYSIS OF POWER PLANT IMPACT ON FISH POPULATIONS,

Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 6G.
W86-05561

LARGE-SCALE RISK ASSESSMENT OF ACID RAIN IMPACTS ON FISHERIES: MODELS AND LESSONS,

Canada Centre for Inland Waters, Burlington (Ontario).
C. K. Minns, J. R. M. Kelso, and M. G. Johnson.
Canadian Journal of Fisheries and Aquatic Science CJFSBX Vol. 43, No. 3, p 900-921, March 1986. 10 fig, 10 tab, 65 ref.

Descriptors: *Acid rain, *Model studies, *Fisheries, *Productivity, *Impact assessment, Atmospheric pollutants, Sulfur dioxide, Nitrogen oxides, Ontario, Canada, Lakes, Regional scale impacts, Prediction.

Two models designed to provide large-scale risk assessment in the context of long-range transport of atmospheric pollutants, particularly SO2 and NOx, are presented and their strengths and weaknesses are identified. One model resulted from a contract with Hough, Stansbury and Michalski Ltd. and J.E. Hanna Associates Inc. (HSM-H Model) to design, assess, and apply a methodology that would: (1) determine quantitatively and qualitatively those game fish assemblages in acid-vulnerability inland Ontario (Canada) lakes; (2) estimate their current productivity; and (3) predict their potential rate of change under various acid deposition rates. The other, derived from an Adaptive Management Modelling Workshop facilitated by Environmental and Social Systems Analysts, Ltd. (ESSA Model) had the following objectives: (1) developing a preliminary model of regional scale impacts from acid deposition and (2) identifying information needs to improve such a model. The HSM-H and ESSA models are analyzed and compared and their strengths and weaknesses are identified. In addition, the models are assessed in relation to other efforts to predict impacts. (Rochester-PTT)
W86-05565

MICROBE-MEDIATED EFFECTS OF LOW PH ON AVAILABILITY OF DETRITAL ENERGY TO A SHREDDER, CLISTORONIA MAGNIFICA (TRICHOPTERA: LIMNEPHILIDAE),

Simon Fraser Univ., Burnaby (British Columbia).
Dept. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W86-05568

SPRING POND WATER CHEMISTRY AND THE REPRODUCTION OF THE WOOD FROG, RANA SYLVATICA,

Quebec Univ., Montreal. Dept. of Biological Sciences.
C. Gascon, and D. Planas.
Canadian Journal of Zoology CJZOAG, Vol. 64, No. 2, p. 543-550, February 1986. 2 fig, 6 tab, 28 ref.

Descriptors: *Acid rain, *Water pollution effects, *Rana sylvatica, *Hydrogen ion concentration, *Egg mass abundance, *Embryo survival, *Acidity, *Total organic carbon, Hatching success, Molds, Reproduction, Snowmelt, Spring season, Quebec, Canada.

To determine the impact of snowmelt water quality on egg mass abundance and embryo survival of the wood frog (Rana sylvatica) in Quebec, Canada, 15 breeding ponds, with an early spring pH range between 3.4 and 6.7, were surveyed. Acidity and total organic carbon were correlated with the density of egg masses. Hatching success was reduced, and mold increased, in low-pH ponds. (Author's abstract)
W86-05569

EFFECTS OF STREAM REGULATION ON DENSITY, GROWTH, AND EMERGENCE OF TWO MAYFLIES (EPHEMEROPTERA: EPHEMERELLIDAE) AND A CADDISFLY (TRICHOPTERA: HYDROPSYCHIDAE) IN TWO ROCKY MOUNTAIN RIVERS (U.S.A.),

Montana Univ., Bigfork. Biological Station.
For primary bibliographic entry see Field 6G.
W86-05570

EFFECTS OF COAL-FIRED THERMAL POWER PLANT DISCHARGES ON AGRICULTURAL SOIL AND CROP PLANTS,

Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, and M. A. Khan.
Environmental Research ENVRAL, Vol. 39, No. 2, p 405-417, April 1986. 7 tab, 27 ref.

Descriptors: *Water pollution effects, *Thermal pollution, *Thermal powerplants, *India, *Soil chemistry, *Irrigation water, *Plant growth, *Germination, *Cooling towers, *Scrubbers, *Wash water, Pea, Wheat, Kasimpur, Coal-fired plant, Hydrogen ion concentration, Organic matter, Calcium carbonate, Soluble salts, Cation exchange capacity, Conductivity, Nitrogen, Phosphorus, Ammonia, Potassium, Leaching, Pisum sativum, Triticum aestivum, Canals, Upper Ganga Canal.

The physicochemical properties of the upstream and downstream waters from the Upper Ganga canal, discharged cooling tower water, machine washings, and scrubber and bottom ash effluents of the 530 MW Kasimpur (India) coal-fired thermal power plant were determined and their direct effects on fertile soil and indirect effects on pea (Pisum sativum) and wheat (Triticum aestivum) crops were studied. All the effluents were responsible for altering the chemical composition of the soil. The soils irrigated with different effluents exhibited an increase in pH, organic matter, calcium carbonate, water-soluble salts, cation exchange capacity, electrical conductivity, and N and P contents, whereas K content decreased, probably as a result of leaching to lower layers of the soil. Use of undiluted cooling tower effluent resulted in 100% germination of both crops. The germination was restricted to 90% for the two crops when irrigated with machine washings effluents, and to 80% and 70% for pea and wheat, respectively, when irrigation was done with scrubber and bottom ash effluent. Soils irrigated with downstream canal water contained slightly more calcium carbonate, P, and ammonia-N than those receiving upstream canal water. Thoughn 100% germination was obtained with both waters, the growth rate of plants irrigated with the downstream canal water was slightly reduced. (Rochester-PTT)
W86-05573

ACID RAIN: THE INTERNATIONAL RESPONSE,

Council on Environmental Quality, Washington, DC.
For primary bibliographic entry see Field 6E.
W86-05577

KINETIC MODEL OF ALGAL GROWTH INCORPORATING INTRACELLULAR CARBOHYDRATE AND PHOSPHORUS POOLS,

Kyoto Univ. (Japan). Dept. of Environmental and Sanitary Engineering.
For primary bibliographic entry see Field 2H.
W86-05583

REGRESSION MODELS FOR ESTIMATING STORM RUNOFF LOAD AND ITS APPLICATION TO LAKE KASUMIGAURA,

National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
For primary bibliographic entry see Field 5B.
W86-05584

HYPERTROPHY, A CONSEQUENCE OF DEVELOPMENT,

National Inst. for Water Research, Pretoria (South Africa).
R. D. Robarts.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 3, p 167-175, 3 fig, 34 ref.

Descriptors: *Water pollution effects, *Hypertrophy, *Eutrophication, *Developing countries, *Standards, Algae, Nutrients, Macrophytes, Plant growth, Anoxia, Cost analysis, Laguna de Bay, Philippines, Lake McIlwaine, Zimbabwe, Water use, Urbanization, Industrialization, Human population, Potable water, Public health.

Increasing urbanization, industrialization, and population growth in developing countries of the Third World potentially will increase the number of hypertrophic freshwater ecosystems unless suitable effluent and water quality standards are promulgated. Unchecked eutrophication, or enrichment, of freshwater with plant growth nutrients leads to hypertrophy. Hypertrophic systems are those that have been enriched to the point where massive algal and/or macrophyte populations appear and major changes in ecosystem structure occur. While these systems are highly productive, they also tend to be ecologically unstable. Algal population collapses or hugh oxygen demands from anaerobic hypolimnia at lake overturn can lead to whole-lake anoxia. Hypertrophy can result in the severe impairment of water use, increased costs to provide potable water, and cause major health problems. Laguna de Bay, Philippines, and Lake McIlwaine, Zimbabwe, are described as examples of hypertrophic systems from the Third World, and remedial measures for hypertrophic lakes are discussed. (Rochester-PTT)
W86-05590

ENVIRONMENTAL IMPACT STATEMENT: MARTIN LAKE D AREA LIGNITE SURFACE MINE, HENDERSON, RUSK COUNTY, TEXAS.

Environmental Protection Agency, Dallas, TX. Region VI.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-176628. Price codes: A17 in paper copy, A01 in microfiche. Draft Report EPA 906/9-83-003, March 1983. 295 p, 25 fig, 34 tab, 3 append.

Descriptors: *Environmental Impact Statement, *Lignite, *Surface mine, *Streams, *Environmental effects, *Ecological effects, Wastewater outfall, Wastewater, Erosion, Water quality control, Todd Branch, Boggy Branch, Dry Creek, Dogwood Creek, Boggy Creek, Mill Creek, Rusk County, Texas.

Texas Utilities Generating Company has applied for an NPDES permit for wastewater discharges from various sedimentation ponds to be located within the mine permit area. Streams receiving wastewater would include Todd Branch, Boggy Branch, Dry Creek, Dogwood Creek, Boggy Creek, Mill Creek and other unnamed tributaries. Lignite would be mined for 30 years from 16,600 acres at a rate of 1.5 million tons per year initially increasing to 3.5 million tons yearly in 1987. Lignite would be hauled by truck to a crusher at the mine site then transported by rail to Martin Lake Steam Electric Station for burning. Earth would be disturbed by mining to depths varying to 150 feet and by construction of ponds, diversions, haul roads, railroad, and transmission lines. Environmental changes include loss of existing topsoils, loss of native vegetation and wildlife habitat, removal of wetlands, reduction of species diversity, water quality and stream flow changes, disruption to ground water levels, loss of water wells, and land use changes. Mine and reclamation plans proposed include random mix of spoil for revegetation primarily with bermuda grass and pine forest species. Long term impacts would depend on success of land reclamation and level of maintenance for stability in revegetation. Air and water quality control measures are proposed to reduce fugitive dust, crusher emissions, stormwater runoff, erosion and sedimentation. Archeological and historic sites are expected to be lost or damaged; some sites will require mitigation measures for recovering significant historical data. The project is estimated to provide 240 jobs, and have a payroll of about $4,000,000 annually. The government will generate additional taxes. Area health, educational, governmental, housing, and commercial serviced needs will increase due to induced population increases. (Author's abstract)
W86-05609

BIOLOGY OF AQUATIC MICROORGANISMS WHICH ARE POTENTIALLY PATHOGENIC TO MAN (ECOLOGIE DES MICROORGANISMES DE L'ENVIRONNEMENT AQUATIQUE SUSCEPTIBLES DE DEVENIR PATHOGENES POUR L'HOMME),

Strasbourg-1 Univ. (France).
C. Derr-Harf, and H. Monteil.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1015-1028, 4 tab, 10 ref.

Descriptors: *Aquatic microorganisms, *Pathogens, Alsace, France, Amoebae, Bacteria, Organic pollution, Environmental effects, Ecological effects.

Potential pathogenic microorganisms were studied in Alsatian ground water which is the largest fresh water supply of this type in France. Free-living amoebae and bacteria are located in their natural site. Some of the organisms are potential pathogens for man, others seem to reflect organic pollution due to human or animal activities. Subsequently, this may allow the influence of physical and chemical variations on the stability of this ecosystem to be judged. (See also W86-05679) (Author's abstract)
W86-05718

BEHAVIORAL REACTIONS OF FATHEAD MINNOW (PIMEPHALES PROMELAS) AND RAINBOW TROUT (SALMO GAIRDNERI) TO A COAL LIQUID WATER-SOLUBLE FRACTION,

Battelle Pacific Northwest Labs., Richland, WA. Environmental Sciences Dept.
D. D. Dauble, R. H. Gray, E. W. Lusty, J. R. Skalski, and M. A. Simmons.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE82-002674, Price codes: A02 in paper copy, A01 in microfiche. Report No. PNL-SA--10439, September 1982. 7 p, 2 fig, 8 ref. Contract No. DE-AC06-76RLO-1830.

Descriptors: *Fish behavior, *Fathead minnows, *Rainbow trout, *Phenols, *Coal liquid, Pimephale promelas, Salmo gairdneri, Water pollution effects, Solvent refined coal, Industrial wastewater, Fish toxins, Mortality, Toxicity.

A laboratory study was conducted to determine the behavioral response of fathead minnow (Pimephales promelas) and rainbow trout (Salmo gairdneri) to sublethal and lethal concentrations of a coal liquid water-soluble fraction (WSF). As coal liquefaction processes are developed, synfuel residuals may be released to aquatic environments. Accurate assessment of potential effects of these materials will depend on information from a variety of studies, including behavior response. When WSF was introduced to a tank containing fathead minnows, almost all moved immediately to one or more of the control chambers. Avoidance of all concentrations >3.0 mg/l total phenols was noted in the first test series. Avoidance of average phenol concentrations >1.7 mg/l phenols also occured in the second test series. In a third series of tests, fathead minnows avoided concentrations of 1.7 mg/l total phenols in test chambers, but showed no response at concentrations of 0.7 mg/l in the center of the tank. Response of rainbow trout to the coal liquid WSF was different than that of fathead minnows. Although the central portion of the apparatus was usually the preferred location for trout during pre-exposure and post-exposure periods, fish did not avoid the toxicant by moving into control chambers during exposure periods. At concentrations of 3.1 and 6.3 mg/l phenols, rainbow trout remained in the center of the apparatus despite mortalities which exceeded 50% of the test population. At lower concentrations (2.4 and 4.6 mg/l phenols) rainbow trout still preferred to remain in the center, while fish moved from the center with 1.0 mg/l phenols to chambers with toxicant concentrations > 2.2 mg/l phenols. Rainbow trout appeared to be attracted to concentrations near 2.0 mg/l. (Lantz-PTT)
W86-05803

EFFECTS OF FLOODING AND SEDIMENTATION ON GERMINATION AND SURVIVAL OF LUDWIGIA LEPTOCARPA (NUTT.) HARA,

Georgia Univ., Athens.
For primary bibliographic entry see Field 5G.
W86-05804

EFFECTS ON CATTLE FROM EXPOSURE TO SEWAGE SLUDGE,

Metropolitan Denver Sewage Disposal District No. 1, CO.
J. C. Baxter, D. Johnson, E. Kienholz, W. D. Burge, and W. N. Cramer.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-170589, Price codes: A06 in paper copy, A01 in microfiche. Report No. EPA-600/2-83-012, February 1983. 155 p, 17 fig, 69 tab, 147 ref, 3 append. Contract No. 68-03-2210.

Descriptors: *Sludge, *Wastewater, *Sludge utilization, *Cattle, *Sludge disposal, Heavy metals, Zinc, Copper, Nickel, Cadmium, Tissue analysis, Toxicity.

Soils, forages, and cattle grazing on a sludge disposal site were examined for trace metals and persistent organics. Soils at the disposal site had increased concentrations of Zn, Cu, Ni, Cd, and Pb. Forages from sludge applied soils had higher levels of Zn, Cd, Cu, and Ni and lower Pb concentrations then forages from soils that had not received sludge. Cattle grazing on the sludge disposal site were healthy with no signs of pathology. Tissues from these cattle did not show elevated levels of metals or persistent organics when compared with cattle not exposed to sewage sludge. Sewge sludge was added to the diets of cattle to simulate worse case conditions of cattle grazing sludge fertilized pastures. The sludge had no positive or negative effects on cattle health or performance but did act as a diet diluent. The direct ingestion of sewage sludge led to increased levels of Cd and Pb in kidney and liver tissues. The amount of Cd increase was related to: 1) the concentration of Cd in the diet; 2) the Cd source (Ft. Collins sludge vs. Metro Denver sludge), and 3) the time period of sludge ingestion. Copper, Pb, and Cd in liver tissues were shown to increase in a linear fashion during sludge ingestion. Cadmium did not decrease in liver or kidney tissues when sludge was removed from the diet. Persistent organics were concentrated in fat tissues of cattle that consumed sewage sludge. The effects to cattle from exposure or ingestion of sewaage sludge appear benign. Thus, the principal health hazards associated with grazing cattle on sludge fertilized pastures would be the possibility of increased levels of heavy metals entering the human food chain through kidney and liver consumption. Additional studies were conducted measuring the die-off rate of pathogens in liquid sludge as it dried in earthen drying basins. The number of fecal coliforms, total coliforms, salmonellae, f2 and T7 bacteriophages, and Ascaris ova decreased rapidly as the sludge dried. (Author's abstract)
W86-05808

EFFECTS OF ATRAZINE AND 2,4-DICHLOROPHENOXYACETIC ACID TO THE POPULATION DENSITY OF PHYTO- AND ZOOPLANKTON IN AN AQUATIC OUTDOOR SYSTEM,

Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Oekologische Chemie.
L. Peichl, J. P. Lay, and F. Korte.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAQ, Vol. 18, No. 5, p 217-222, October 1985. 7 fig, 21 ref.

Descriptors: *Herbicides, *Water pollution effect, Plankton, *Phytoplankton, *Zooplankton, Atrazine, Organochlorine pesticides, Rotifers, Bioindicators, Daphnia, Field tests, Ponds, Mortality.

Changes of the physico-chemical parameters and of the phyto- and zooplankton population were measured following application of 0.01 mg/l Atrazine, 1 mg/l 2,4-dichlorophenoxyaceticacid (2,4-D as well as both chemicals together. In a field study, using pond compartments of 1000 liter contents. An increase in rotifer density was determined. This was due to changes in phytoplankton composition and showed rotifers to be sensitive indicator organisms for the effects of low dose chemicals. The combined application of both chemicals potentiated the effects and caused a complete mortality of Daphnia pulex. (Master-PTT)
W86-05825

SEVERE HEPATOTOXICITY CAUSED BY THE TROPICAL CYANOBACTERIUM (BLUE-GREEN ALGA) CYLINDROSPERMOPSIS RACIBORSKII (WOLOSZYNSKA) SEENAYA AND SUBBA RAJU ISOLATED FROM A DOMESTIC WATER SUPPLY RESERVOIR,

James Cook Univ. of North Queensland, Townsville (Australia). Dept. of Botany.
P. R. Hawkins, M. T. C. Runnegar, A. R. B. Jackson, and I. R. Falconer.
Applied and Environmental Microbiology AEMIDF, Vol. 51, No. 5, p 1292-1295, November 1985. 3 fig, 18 ref.

Descriptors: *Hepatotoxicity, *Cyanobacterium, *Drinking water, *Reservoirs, Cylindrospermosis rackiborskii, Palm Island, Australia, Algae, Human diseases, Public health.

Cylindrospermopsis rackiborskii, a tropical blooming species of cyanobacterium (blue-green alga), was isolated from the domestic water supply reservoir on Palm Island, off the tropical northeast coast of Australia. This species, not known to be toxic, was severely hepatoxic for laboratory mice. An injection of 64 mg of freeze-dried culture/kg of mouse was 50% lethal at 24 hr. The mice had livers with hepatocellular coagulative necrosis and abnormalities in the lungs, kidneys, adrenal glands, and intestine. This evidence implicates the C. raciborskii as being responsible for an outbreak of hepatoenteritis in the human population consuming water from the Solomon Dam, a place where alga C. raciborskii is known to bloom seasonally. (Adams-PTT)
W86-05828

PERSISTENCE OF PENTACHLOROPHENOL IN A WASTEWATER-ESTUARINE AQUACULTURE SYSTEM,

Florida Inst. of Tech., Melbourne. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W86-05832

CRUDE DUBAI OIL TOXICITY ON SOME FRESH-WATER INVERTEBRATES,

Milan Univ. (Italy). Sezione di Ecologia.
M. C. Ramusino, and D. Zanzottera.
Bulletin of Environmental Contamination and Toxicology BECTAG, Vol. 36, No. 1, p 150-158, January 1986. 6 fig, 1 tab, 7 ref.

Descriptors: *Oil pollution, *Invertebrates, *Oil toxicity, *Isopods, *Water pollution effects, Freshwater, Lethal limit, Po River, Oil spills, Oxygen transfer.

A crude oil spill occurred in the Po River in April, 1980. A toxicity study was carried out to evaluate the effects of the oil on a common invertebrate species, using both crude Dubai oil 'as it is' and its 'water-soluble fraction' (SFW), obtained by mixing 20 liters of normal tap water and 500 grams of crude Dubai. The findings indicate the impossibility of oxygen exchange between the solutions and the overlying air, regardless of the thickness of the surface crude oil. Asellus aquaticus, a common detrivore in the Po River, had a mortality rate between 70% and 80% in the test basins with 16.3 mg/L and 17.9 mg/L concentrations respectively. Plecoptera and Tripcoptera larvae behavior was not very different when treated with 35.8 mg/L and 17.9 mg/L concentrations of SFW, but 8.9 mg/L concentration had no severe toxic effect. No death has been reported in the basins containing Phisa acuta (Gastropod). The results with Anphipodus Echinogammarus stammeri were similar to the Asellus aquaticus study. (Adams-PTT)
W86-05835

PRELIMINARY INVESTIGATION OF EFFECTS OF SUBLETHAL ACID EXPOSURE ON MATERNAL BEHAVIOR IN THE CRAYFISH ORCONECTES VIRILIS,

Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
R. L. France.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 35, No. 5, p 641-645, November 1985, 1 fig, 1 tab, 14 ref.

Descriptors: *Crayfish, *Reproduction, *Acid rain, *Hydrogen ion concentration, *Sublethal effects, Ontario, Crustaceans, Littoral zone, Lakes, Oligotrophic lakes.

The occurrence of crayfish inhabiting the littoral regions of many oligotrophic acid sensitive lakes makes these organisms vulnerable to spring pH decreases. To understand how a toxicant affects crayfish reproduction it is necessary that the maternal and embryonic responses to experimental perturbation be separated. Ovigerous age 2-3 (20-30 mm carapace length) Orconectes virilis (Hagen) were collected during June 1980 from Lake 240, a control (pH 6.6-6.8) basin in the Experimental Lakes Area, northwestern Ontario. Over the range tested, pH had no effect on either vibration frequency or duration of the vibration period. At low pH egg aeration decreased. The experiment suggests that when encountering acidified water, the need of ovigerous females to satisfy their own increased demand for oxygen may override maternal behavior to developing eggs. (Jones-PTT)
W86-05849

PERSISTENCE AND MUTAGENIC POTENTIAL OF HERBICIDE-DERIVED ANILINE RESIDUES IN POND WATER,

Cook Coll., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
For primary bibliographic entry see Field 5B.
W86-05851

CHLORINATED PHENOLICS AND THEIR CONJUGATES IN THE BILE OF TROUT (SALMO GAIRDNERI) EXPOSED TO CONTAMINATED WATERS,

Joensuu Univ. (Finland).
A. Oikari, and E. Anas.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 35, No. 6, p 802-809, December 1985, 4 fig, 12 ref.

Descriptors: *Chlorinated hydrocarbons, *Trout, *Pulp wastes, *Water pollution effects, Fish, Chlorophenols, *Phenolics, Effluents, Bleached kraft pulp mill effluents, Kraft mills.

With spent liquors from the bleaching of Kraft pulp a wide variety of chlorinated organic substances are discharged into the environment. Of these compounds chlorinated phenolics are the most toxic to fishes and other aquatic organisms. With the exception of pentachlorophenol (PCP) there is very little information on the metabolic fate of various chlorophenols and other related phenolics, characteristic of bleached Kraft pulp mill effluents (BKME), in the fish body. Juvenile trout were exposed to a solution of BKME. Metabolites in the bile of trout were investigated by hydrolyzing them with a strong base and with specific ensymes. In the bile of trout exposed to BKME, conjugation approached 100%. Concentrations of free chlorophenols in the blood plasma were about half those in the bile. The presence of chlorophenol conjugates in the plasma suggests that some of the molecules conjugated in the hepatocytes re-enter the circulation and are then excreted either through the kidneys or the gills. Even at very low concentrations of BKME (0.6-2% BKME at 5 microgram:l or less) the phenolics absorbed are almost entirely metabolized before hepatic disposition. This situation may be representative of that caused by the chronic aquatic pollution adjacent to kraft pump mills. (Jones-PTT)
W86-05853

FREE AMINO ACID PATTERN IN BLUE MUSSEL (MYTILUS EDULIS) EXPOSED TO CRUDE OIL,

Turku Univ. (Finland).
J. Soini, and P. Rantamaki.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 35, No. 6, p 810-815, December 1985. 3 tab, 16 ref.

Descriptors: *Amino acids, *Blue mussels, *Crude oil, Cold water, Low salinity, Oil pollution, Baltic Sea, Aquatic animals, Mollusks.

Levels of free amino acids in the tissues of aquatic organisms change under environmental stress. This study investigates changes of free amino acid levels in different tissues of Mitilus edulis exposed to low concentrations of crude oil. The extreme conditions (cold water, low salinity) of the Archipelago of Turku in the northern area of the Baltic Sea probably make the mullusk Mitilus edulis especially sensitive to chemical changes in the water. The experiment consisted of collecting blue mussels and keeping them in conditions similar to those of the water where the mussels were collected. Under controlled conditions crude oil was added to the water. The concentrations of 12 free amino acids increased in the gills and mantle of the mussels during the oil treatment which suggests that proteolysis had occurred. (Jones-PTT)
W86-05854

DENSITY, BIOMASS, AND RESPIRATION OF PHYTOPHILOUS MACROFAUNA OF ASSOCIATIONS OF POTAMOGETON PERFOLIATUS L. OF A POLYMICTIC, EUTROPHIC LAKE,

Department of Environmental Protection, Poznan (Poland).
K. Kasprzak.
Acta Hydrobiologica, Vol. 27, No. 1, p 63-73, 1985. 5 fig, 3 tab, 21 ref.

Descriptors: *Density, *Biomass, *Respiration, *Eutrophic lakes, *Potamogeton, Ecosystems, Macroinvertebrates, Aquatic populations, Macrofauna, Metabolism.

In a eutrophic and polymictic lake situated in an area of intense agriculture the numbers, biomass, and respiration of phytophilous macrofauna of Potamogeton perfoliatus L. associations were investigated. The mean total biomass of macrofauna on the investigated plant communities was 13.5 g dry weight/sm. Predators constituted the greatest share in the biomass (79%), and phytophages in density (76%). Predators were also characterized by an intensive metabolism reaching up to 75% of the mean macrofauna respiration of P. perfoliatus associations during the vegetation season. (Author's Abstract)
W86-05892

HEAVY METAL POLLUTANT TOLERANCE OF AZOLLA PINNATA,

Burdwan Univ. (India). Dept. of Botany.
A. Sarkar, and S. Jana.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 1-2, p 15-18, January 1986. 1 tab, 12 ref.

Descriptors: *Heavy metals, *Ecological effects, *Azolla pinnata, Floating plants, Aquatic plants, Ferns, Mercury, Arsenic, Lead, Copper, Cadmium, Chromium, Chlorophy II, Photosynthesis.

The effects of Hg, As, Pb, Cu, Cd, and Cr (1, 2, and 5 mg/l) on Azolla pinnata R. Br., a floating aquatic heterosporous fern which contains an endophytic cyanobacterium, Anabaena azollae, were analyzed. The treatments (2 and 5 mg/l) of the heavy metal pollutants decreased Hill activity, chlorophyll, protein and dry wt, and increased tissue permeability over control values. The effects were most pronounced with the treatment of 5 mg/l. The harmful effects of the metals were, in general, found by the treatments in the order: Cd > Hg > Cu > As > Pb > Cr. There was no significant change in these parameters at 1 mg/l of the metals over control. Thus Azolla pinnata shows tolerance to the heavy metals tested up to 1 mg/l each. (Doria-PTT)
W86-05910

MONITORING THE IMPACT OF ACID DEPOSITION ON THE SOIL MICROBIOTA, USING GLUCOSE AND VANILLIN DECOMPOSITION,

Calgary Univ. (Alberta). Dept. of Biology.
R. J. F. Bewley, and D. Parkinson.
Water, Air, and Soil Pollution WAPLAC, Vol. 27, No. 1-2, p 57-68, January 1986. 2 fig, 4 tab, 36 ref.

Descriptors: *Ecological effects, *Acid rain, *Soil environment, *Microorganisms, Metabolism, Soil contamination, Forest soils, Biomass, Biodegradation, Microbial degradation, Organic soils, Sulfur compounds, Bacteria.

Samples of organic and mineral soil (to approximately 8 cm depth) were collected from three 'ecologically analogous' sites in a boreal forest at intervals of 2.8 km (site 1), 6.0 km (site 2) and 9.6 km (site 3) from a 'sour gas' plant emitting SO2. The organic soil of site 1 was characterized by a lower basal respiration rate, smaller microbial biomass, and a longer time to attain the peak rate of CO2 efflux following enrichment with glucose or vanillin (0.15 and 0.1 g/15 g soil, respectively). No significant differences were detected between the mineral soils of the 3 sites in terms of the rate or extent of glucose decomposition (0.1 g/100 g soil), but there was a significant retardation in vanillin decomposition in the mineral soil of site 1 (0.05 g/100 g soil). Concentrations of 0.075 and 0.1 g vanillin (per 100 g soil) were decomposed in the mineral soil of sites 2 and 3, but not at site 1. Following incubation with vanillin, fewer bacteria were isolated from both the organic and mineral soils of site 1, and a greater proportion of these were spore formers and bisulfite-tolerant isolates. (Doria-PTT)
W86-05913

EFFECT OF AGRICULTURAL AND RESIDENTIAL DEVELOPMENT ON AQUATIC MACROPHYTES IN THE NEW JERSEY PINE BARRENS,

Rutgers - The State Univ., Camden, NJ. Dept. of Biology.
M. D. Morgan, and K. R. Philipp.
Biological Conservation, Vol. 35, No. 2, p 143-158, March 1986. 3 fig, 2 tab, 36 ref.

Descriptors: *Regional development, *Agricultural development, *Residential development, *Aquatic plants, *Macrophytes, *New Jersey Pine Barrens, *Water pollution effects, Agriculture, Water pollution, Water pollution sources, Wetlands, Species diversity, Hydrogen ion concentration, Nitrates.

The impact of residential and agricultural development as the cause of water pollution on aquatic macrophyte communities in the New Jersey Pine Barrens was examined by comparison with unpolluted communities. The only major physical and chemical differences between stream types were greatly elevated pH values and NO3(-) concentrations at the polluted sites. A total of 59 aquatic macrophyte species were identified during the study. Only a few more species (41) occurred at the polluted sites (38). Twentytwo species were confined to polluted sites, and 19 to unpolluted sites. Classification of all species as either typical or non-typical Pine Barrens species revealed that the primary effect of pollution was the replacement of a distinctive Pine Barrens flora (e.g., Carex walteriana, Eleocharis olivacea, E. tuberculosa, Eriocaulon compressum, and Utricularia fibrosa) with one containing many marginal or non-indigenous species common to wetlands throughout the Eastern US (e.g., Callitriche heterophylla, Galium tinctorium, and Polygonum punctatum). (Doria-PTT)
W86-05935

EFFECTS OF OIL SPILL CHEMICALS ON TRANSPIRATION, CO2 EXCHANGE, AND CUTICULAR STRUCTURE IN SALIX INTERIOR,

Alberta Univ., Edmonton. Dept. of Botany.
J. S. Goudey, M. Dale, and J. Hoddinott.
Canadian Journal of Botany, Vol. 63, No. 12, p 2340-2344, December 1985. 2 fig, 1 tab, 18 ref.

Descriptors: *Oil spills, *Dispersants, *Water pollution effects, *Willow trees, *Transpiration, Plant physiology, Corexits, Leaves, Cuticular transpiration, Carbon dioxide, Toxicity.

The effects of three oil spill chemicals (Corexit 9600, 9550, and 7664) on cuticular structure and function in the sandbar willow Salix interior were assessed from direct observations of the leaf surface, using scanning electron microscopy, and from measurements of water loss through transpiration. Rates of CO2 exchange in the light and dark were also measured. Although the Corexits coated the leaf surfaces, wax plates (crystals) associated with the cuticle were not visibly altered. The dispersants did not increase rates of evaporative water loss, although rates of net CO2 assimilation in the light were reduced. Measurements of surface contact angles and observations on the movement of dye-dispersant mixtures indicated that the rapid inhibition of CO2 assimilation resulted from the spontaneous infiltration of stomata by the dispersants and direct action on the internal tissues of the leaf. Rates of dark respiration were initially unaffected but decreased after one day. Further reductions in rates of CO2 exchange were observed over the first four days; rates then increased following new tissue growth. Although the dispersants are potent contact poisons, damage to the protective cuticle in Salix interior does not appear to be a major contributing factor to their toxicity. (Doria-PTT)
W86-05938

OIL REFINERY EFFLUENTS: EVIDENCE OF COCARCINOGENIC ACTIVITY IN THE TROUT EMBRYO MICROINJECTION ASSAY,

Trent Univ., Peterborough (Ontario). Environmental and Resource Studies Program.
C. D. Metcalfe, and R. A. Sonstegard.
Journal of the National Cancer Institute, Vol. 75, No. 6, p 1091-1097, December 1985. 1 fig, 6 tab, 28 ref.

Descriptors: *Effluents, *Oil refineries, *Water pollution effects, *Carcinogens, *Trout, Industrial wastes, Oil industry, Industrial plants, Bioassay, Assay, Oil wastes.

Extracts prepared from oil refinery effluents (soxhlet and XAD-2) were tested for carcinogenic potential by means of embryo-injection bioassay in rainbow trout (Salmo gairdneri). No neoplasms were detected in fish injected with refinery extracts alone (with and without exogenous rat S-9 activation). Refinery extracts coinjected with aflatoxin B1 induced elevated frequencies of hepatic neoplasms. This cocarcinogenic effect was most pronounced when aflatoxin B1 was preincubated with rat S-9 prior to injection. Effluent extracts coinjected with a direct-acting carcinogen (N-methyl-N'-nitro-N-nitrosoguanidine (CAS: 56-57-5)) did not increase the incidence of hepatic neoplasms (with or without exogenous S-9 activation). There was an increase in the incidence of spinal curvatures among fish exposed to the extracts but it was noticeable only among treatments without preincubation with S-9. (Doria-PTT)
W86-05948

SURVIVAL AND HEPATIC METALLOTHIONEIN IN DEVELOPING RAINBOW TROUT EXPOSED TO A MIXTURE OF ZINC, COPPER, AND CADMIUM,

Victoria Univ. (British Columbia). Dept. of Biochemistry and Microbiology.
M. Roch, and J. A. McCarter.
Bulletin of Environmental Contamination and Toxicology, Vol. 36, No. 2, p 168-175, 1 fig, 6 tab, 15 ref.

Descriptors: *Water pollution effects, *Fish, *Mortality, *Metallothionein, *Trout, *Zinc, *Copper, *Cadmium, Growth, Bioassay, Metals, Heavy metals, Survival.

Rainbow trout alevins were exposed to zinc, copper and cadmium mixtures. Metallothionein concentrations in livers were correlated to metal concentrations in the water. Retarded growth and mortality were noted. There was considerable variability in response depending on the source of the rainbow trout and the stage of development but the differences were not due to water quality. (McFarlane-PTT)
W86-05993

SURVIVAL OF SALMO GAIRDNERI (RAINBOW TROUT) IN THE ZINC POLLUTED MOLONGLO, RIVER NEAR CAPTAINS FLAT, NEW SOUTH WALES, AUSTRALIA,

Canberra Coll. of Advanced Education, Belconnen (Australia). Water Research Centre.
G. A. Graham, G. Byron, and R. H. Norris.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 2, p 186-191, February 1986, 1 fig, 1 tab, 7 ref.

Descriptors: *Fish, *Trout, *Zinc, *Water pollution effects, *Molonglo River, *Acid mine drainage, *Survival, New South Wales, Australia, Copper, Rehabilitation.

The Molongo River was polluted by gold, lead, zinc and copper mines between 1938 and 1962. Acid mine water and finely divided tailings included high concentrations of base metals. Stabilization and rehabilitation of mine workings and waste deposits was initiated in 1974. River water quality was unsuitable for rainbow trout survival both before and after closure of the mine. Present concentrations of zinc and copper in water downstream from mine site are 50-60 times higher than found in water upstream from the mine. Caged trout can survive upstream of the mine but not downstream. The extensive rehabilitation of the abandoned mine workings has been ineffective. (McFarlane-PTT)
W86-05994

CHROMATIN CONDENSATION IN THE ERYTHROCYTES OF FISH FOLLOWING EXPOSURE TO CADMIUM,

Kumaun Univ., Naini Tal (India). Dept. of Zoology.
T.S. Gill, and J. C. Pant.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 2, p 199-203, February 1986, 3 fig, 20 ref.

Descriptors: *Cadmium, *Toxicity, *Water pollution effects, *Fish, Erythrocytes.

Experimental chronic cadmium poisoning caused chromatin condensation within the erythrocytes of a freshwater fish, Puntius conchonius. Cadmium causes nuclear anomalies including clumping of chromatin material and an increase in interchromatin spaces in the erythrocyte nuclei. (McFarlane-PTT)
W86-05995

SOIL ALGAE IN POLLUTED SOILS,

Kirovskii Selskokhozyaistvennyi Inst. (USSR).
E. A. Shtina, L. B. Neganova, T. A. Yel'shina, I. I. Shilova, and M. F. Andronova.
Soviet Soil Science, Vol. 17, No. 6, p 18-27, Nov/Dec 1985. 4 tab, 28 ref. Translated from Pochvovedeniye, No. 10, p 97-106, 1985.

Descriptors: *Soil pollution, *Cyanophyta, *Chlorophyta, *Chrysophyta, *Diatoms, *Soil microflora, *Oil pollution, *Air pollution, Algae, Smoke, Gas, Kama River, USSR, Self-purification, Alkalinity, Acidification, Saline soils, Mine drainage, Bioindicators, Succession, Oil wells, Bioindicators.

Pollution of the soil during oil extraction in the Kama River region near Perm (USSR) caused distinct changes in soil algae, ranging from inhibition or complete extermination of certain groups of algae, e.g., blue-green as a result of pollution (smoke and gas emissions) or yellow-green algae whenever the soil was altered by acidification, alkalinization, or petroleum pollution. The algal synousiae became impoverished without the appearance of new species. As self-purification of the soil occurs, the algal flora may recover. Sometimes the original algal communities are completely replaced by others. Depending on the salt composition of the soils or substrates, either blue-green algae (sodium chloride Solonchaks in the zone affected by oilfield waste water) or diatoms (acidic iron-sulfate Solonchaks in the zone affected by mine water) become dominant. In some cases algae completely disappear, e.g., after partial sterilization of the soil in places exposed to smoke and gas emissions or large quantities of oil. The diverse reactions of soil algae to the different kinds of soil pollution suggests that they may be of considerable importance as indicators. (Rochester-PTT)
W86-06010

ECOLOGICAL CONSEQUENCE ASSESSMENT: EFFECTS OF BIOENGINEERED ORGANISMS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5B.
W86-06011

EFFECTS OF SALINITY ON PREFERRED AND LETHAL TEMPERATURES OF THE MOZAMBIQUE TILAPIA, OREOCHROMIS MOSSAMBICUS (PETERS),

Pennsylvania State Univ., University Park. Dept. of Fishery Science.
J. R. Stauffer, Jr.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 205-208, April 1986. 4 tab, 25 ref.

Descriptors: *Acclimatization, *Lethal temperatures, *Salinity, *Tilapia, Freshwater, Thermal stress, Exotic species.

The final preferred temperature Oreochromis mossambicus acclimated to freshwater was 32.2 C, which was significantly (p less than 0.05) lower than final preferred temperatures of fish acclimated at 15% and 30% salinity. The thermal tolerance zone of 0 mossambicus ranged between 15 and 37 C and was not affected by acclimation to different salinity levels. It is postulated that O. mossambicus can expand its existing range throughout the southern portion of North America and that the presence of industrial thermal outfalls may maintain populations in marginal areas during cold weather. (Rochester-PTT)
W86-06014

USE OF PROTOZOAN COMMUNITIES TO PREDICT ENVIRONMENTAL EFFECTS OF POLLUTANTS,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
Y.-F. Shen, A. L. Buikema, Jr., W. H. Yongue, Jr., J. R. Pratt, and J. Cairns, Jr.
Journal of Protozoology JPROAR, Vol. 33, No. 2, p 146-151, May 1986. 6 fig, 1 tab, 38 ref.

Descriptors: *Protozoa, *Heterotrophic index, *Bioindicators, *Water pollution effects, *Artificial substrates, *Microcosms, *Heavy metals, *Wastewater, Laboratory microecosystems, Biomass, Chlorophyll, Species diversity, Streams, Field tests.

Sampling stations were established on a small stream receiving heavy metal and sewage treatment plant effluents. Water from each station was used as a test medium to test the colonization of polyurethane foam artificial substrates in laboratory microecosystems. The heterotrophic index (HI), the ratio of total community biomass to chlorophyll biomass, was also measured. Field colonization trials and HI determinations were carried out at each sampling station. There was a strong negative relationship between the number of species colonizing artificial substrates and the total metal concentration of the water at each station; protozoan colonization was severely depressed at the highest metal concentrations (>400 microgram/liter) and recovered at downstream stations where dilution had taken place. The HI differentiated stations receiving high heavy metal concentrations in the field from those recovering from heavy metal influences. Effect concentrations based on laboratory experiments predicted that the concentration of total heavy metal that would produce a 5% decrease in species number was 18 microgram/liter, approximately the background concentration in the stream studied. These experiments demonstrated that laboratory microecosystems or microcosms can be used to predict effects in the field accurately. (Author's abstract)
W86-06027

SALINITY OF MOTORWAY SOILS. III. SIMULATION OF THE EFFECTS OF SALT USAGE AND RAINFALL ON SODIUM AND CHLORIDE CONCENTRATIONS IN THE SOIL OF CENTRAL RESERVES,

Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
For primary bibliographic entry see Field 5B.
W86-06035

SALINITY OF MOTORWAY SOILS. IV. EFFECTS OF SODIUM CHLORIDE ON SOME NATIVE BRITISH SHRUB SPECIES, AND THE POSSIBILITY OF ESTABLISHING SHRUBS ON THE CENTRAL RESERVES OF MOTORWAYS,

Imperial Coll. of Science and Technology, London (England). Dept. of Pure and Applied Biology.
For primary bibliographic entry see Field 5B.
W86-06036

EFFECTS OF HEAVY METALS UPON THE BIOLOGICAL WASTEWATER TREATMENT PROCESS,

For primary bibliographic entry see Field 5D.
W86-06046

EGG MORTALITY OF LAKE GENEVA CHARR (SALVELINUS ALPINUS L.) CONTAMINATED BY PCB AND DDT DERIVATIVES,

Ecole Nationale Veterinaire de Lyon (France). Lab. d'Ecotoxicologie.
G. Monod.
Bulletin of Environmental Contamination and

Toxicology BECTAG, Vol. 35, No. 4, p 531-536, October 1985. 1 tab, 20 ref.

Descriptors: *Water pollution effects, *Egg mortality, *Lake Geneva, *Charr, *Polychlorinated biphenyls, DDT, Incubation, Lipids, DDE, DDD, Organochlorines, Fish eggs, Toxins.

There is a rather high contamination level of various fish species in Lake Geneva due to PCB. Charr are known as one of the most contaminated species. Wild charr were captured, and the ova of females were gathered and fertilized. Each egg sample was divided into two parts. The first part was incubated. The dead eggs were removed daily and preserved. After hatching the dead were also counted until the resorption of the yolk sac. For each spawn the second part was analyzed for PCB and sigma DDT levels. The total mortality was highly variable between spawns. The differences in total mortality from one spawn to another correspond mainly to variations in the levels of eggs with no visible cellular division and of eggs with young embryos. The results show a significant and positive correlation between PCB levels in eggs and total mortality rates. The correlation is equally significant between the PCB level and the percentage of eggs without embryos, as well as the PCB level and the percentage of eggs with young nonsurviving embryos. No correlation appears between the contamination of the eggs and the percentage of observed mortality during the last phases of development. Similar results are obtained with sigma DDT contamination. Results indicate the mortality level from the fertilization of ova to yolk sac resorption increases proportionaly with respect to increase in the contamination level. The correlation between the level of residues and that of eggs with no visible cellular division suggest the female fertility rate of Lake Geneva Charr is influenced by organochlorine pollutants. The correlation between the level of residues and the percentage of dead young embryos would suggest PCB and sigma DDT have a toxic effect on the early stages of embryonic development. (Main-PTT)
W86-06070

CONTAMINATION AND GROWTH OF THE SHRIMP, PENAEUS STYLIROSTRIS STIMPSON, CULTURED IN A SEAWATER/WASTEWATER AQUACULTURE SYSTEM,

Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
For primary bibliographic entry see Field 3C.
W86-06071

ACUTE TOXICITY OF ALDICARB, ALDICARB SULFOXIDE, AND ALDICARB SULFONE TO DAPHNIA LAEVIS,

Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
J. A. Foran, P. J. Germuska, and J. J. Delfino.
Bulletin of Environmental Contamination and Toxicology BECTAG, Vol. 35, No. 4, p 546-550, October 1985. 2 tab, 14 ref.

Descriptors: *Toxicity, *Aldicarb, *Daphnia, *Insecticides, Temik, Pesticides, Fish, Surface water, Florida, High pressure liquid chromotography, Crustaceans.

Aldicarb, the active ingredient in the insecticide Temik, is highly water soluble, and a highly toxic pesticide. The toxicity of aldicarb, aldicarb sulfoxide and aldicarb sulfone to Daphnia laevis was examined. D. laevis obtained from a small pond were cultured and acute toxicity tests conducted. Concentrations of aldicarb ranged from 10 to 200 microgram/L; aldicarb sulfoxide 10 to 200 microgram/L; and aldicarb sulfone 100 to 1250 microgram/L. Toxicant concentrations were measured by HPLC. No change in toxicant concentration was found throughout any experiment. In addition, no hydrolytic or oxidative metabolites were detected. After 48 hours, the LC and EC50 (effective concentration) were determined. The EC50 for aldicarb and aldicarb sulfoxide ranged from 43 to 65 microgram/L for juvenile and adult fish. LC50 data ranged from 70 to 209 microgram/L for aldicarb and aldicarb sulfoxide, and between 900 and 1200 microgram/L for aldicarb sulfone. These data show that aldicarb and its oxidative meatbolites are highly toxic to the D. laevis. ED50 data are only 40 to 60 microgram/L above the USEPA allowable aldicarb level in drinking water. The USEPA is considering raising the acceptable level to 30 to 50 microgram/L in drinking water. The data suggest these concentrations in surface water may have significant detrimental effects. (Main-PTT)
W86-06072

TOXICITY OF COAL GASIFIER SOLID WASTE TO THE AQUATIC PLANTS SELENASTRUM CAPRICORNUTUM AND SPIRODELA OLIGORHIZA,

Memphis State Univ., TN. Dept. of Biology.
S. J. Klaine.
Bulletin of Environmental Contamination and Toxicology, Vol. 35, No. 4, p 551-555, October 1985. 2 fig, 1 tab, 11 ref.

Descriptors: *Toxicity, *Coal gasification, *Solid wastes, *Selenastrum, *Aquatic plants, *Spirodela, *Bioassay, *Leachates, Algae.

Coal gasification plants produce solid and liquid wastes that are potentially hazardous to the environment. Solid waste leaching was tested using a procedure designed to mimic landfilling of solid waste. Ash agglomerate was subjected to an extraction procedure (EP). Total alkalinity, total hardness, pH, total dissolved solids, chemical oxygen demand, total organic carbon, phenols, and total chromium were determined. Leachate toxicity to Selenastrum was determined using growth optimized static bioassays. Leachate toxicity to Spirodela was determined using axenic cultures. No toxic substance was apparent from the chemical analysis of the EP leachate. Values for total organic carbon and chemical oxygen demand indicate that a large amount of organics may leach from the ash agglomerate. These organics had little acute effects on the two organisms tested. Neither organism responded to 10% of the leachate in the bioassays. The EC50 values indicate Selenastrum is more sensitive to the leachate than Spirodela. If the integrity of a landfill were compromised, leachate would impact a receiving stream as a pollutant. Data are need to determine the chronic effects of these types of wastes on plants and animals. (Main-PTT)
W86-06073

HEALTH RISKS ASSOCIATED WITH WASTEWATER IRRIGATION: AN EPIDEMIOLOGICAL STUDY,

Hebrew Univ. of Jerusalem (Israel). School of Public Health.
B. Fattal, Y. Wax, M. Davies, and C. H. I. Shuval.
American Journal of Public Health AJHEAA, Vol. 76, No. 8, p 977-979, August 1986. 3 tab, 7 ref. EPA Grant CR805174.

Descriptors: *Wastewater irrigation, *Human diseases, *Enteric bacteria, *Water reuse, *Israel, Seasonal variation, Crop production, Agriculture, Irrigation.

An analysis of morbidity was made in 11 kibbutzim (cooperative agricultural settlements), with a total population of 3,040, that had switched from nonwastewater to wastewater sprinkler irrigation or vice versa. Partially treated stabilization pond effluent of poor microbial quality was used for irrigation. Vegetables or salad crops were not irrigated with effluent. The results showed that a seasonal, twofold, excess risk of 'enteric' disease was found in the 0 to 4 year-old age group during the summer irrigation, compared with the parallel summer months of nonwastewater irrigation years in the same kibbutz. On the year-round rates basis, little or no excess enteric disease was found in wastewater irrigating communities. (Author's abstract)
W86-06079

BIOLOGICAL AVAILABILITY OF NICKEL ARSENIDES: CELLULAR RESPONSE TO SOLUBLE NISAS2,

Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5B.

W86-06120

HEALTH EFFECTS OF WORK AT WASTE WATER TREATMENT PLANTS: A REVIEW OF THE LITERATURE WITH GUIDELINES FOR MEDICAL SURVEILLANCE,

Boston Univ., MA. School of Medicine.
R. J. McCunney.
American Journal of Industrial Medicine, Vol. 9, No. 3, p 271-279, March 1986. 3 tab, 19 ref.

Descriptors: *Health effects, *Wastewater treatment, *Medical surveillance, Monitoring, Epidemiology, Infection, Diseases.

Potential health hazards associated with work at waste water treatment plants include bacteria, viruses and protozoa in domestic waste and heavy metals and other hazardous substances in industrial wastes. The primary exposure route for hazardous material is through inhalation of aerosols generated in the secondary phase of water treatment that contain pathogenic organisms. Although few epidemiological studies have investigated the health of waste water treatment facility workers, hazards noted have been limited to acute, self-limited gastrointestinal illnesses. Due to the potential for long term or subtle adverse health effects, a medical surveillance program is proposed that includes attention to infectious diseases, such as hepatitis, and to illness/absenteeism records. (Author's abstract)
W86-06129

IMPACT ON PHYTOPLANKTON POPULATIONS OF SEWAGE DISCHARGES IN THE SARONIKOS GULF (WEST AEGEAN),

Institute of Oceanographic and Fisheries Research, Athens (Greece).
N. Friligos.
Water Research WATRAG, Vol. 19, No. 9, p 1107-1118, 1985. 16 fig, 3 tab. 35 ref.

Descriptors: *Wastewater disposal, *Water pollution effects, *Phytoplankton, *Wastewater outfall, Wastewater treatment, Biological wastewater treatment, Ocean dumping, Outfall sewers, Nutrients, Eutrophication.

Measurements were made of temperature, salinity and concentrations of dissolved oxygen, nutrients, chlorophyll a, particulate carbon and nitrogen concentrations in sea water near the Keratsini sewage outfall to make suggestions on the extent of sewage treatment needed and the design of the outfall diffuser. Eutrophication in the area around the outfall is demonstrated by the enhanced chlorophyll a, particulate carbon and particulate nitrogen concentrations. These parameters provide evidence for high phytoplankton standing stock. No appreciable differences in the inorganic nutrient levels between the outfall area and the normal background levels were found, suggesting rapid uptake of nutrients or effective dispersal from the outfall. In the case of oliogotrophic waters and in the absence of the dissolved oxygen depletion, primary treatment is preferable to secondary treatment. A 2000 m long outfall diffuser at a depth of 60 m or more is needed for either primary or secondary effluent to take advantage of stratification. (Geiger-PTT)
W86-06152

IN SITU SEDIMENT OXYGEN DEMAND DETERMINATIONS IN THE PASSAIC RIVER (NJ) DURING THE LATE SUMMER/EARLY FALL 1983,

Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W86-06155

COMPARATIVE TOXICITY OF TEN ORGANIC CHEMICALS TO TEN COMMON AQUATIC SPECIES,

Montana State Univ., Bozeman. Fisheries Bioassay Lab.
R. V. Thurston, T. A. Gilfoil, E. L. Meyn, R. K. Zajdel, and T. I. Aoki.

Water Research, Vol. 19, No. 9, p 1145-1155, 1985. 1 fig, 5 tab, 10 ref, 1 append. EPA grant Nos. CR807240, CR809478.

Descriptors: *Water pollution effects, *Organic compounds, *Aquatic animals, *Toxicity, *Industrial wastes, Fish, *Crustaceans, Amphibians, Midges, Invertebrates, Comparison studies.

The susceptibilities of 10 aquatic organisms to 10 organic chemicals were determined using lethality tests. The species included six fishes, two crustaceans, a chironomid and an amphibian. The chemicals were selected to span the toxicity range from 26 g/liter to 1 microgram/liter and include chemicals which were lethal by four modes of toxic action. There was no consistent relative susceptibility among the test species because the sensitivity to specific modes of toxic action varied among the chemicals. Nonetheless, the toxicities of the chemicals to any given species were highly correlated to the toxicities to other species, particularly among fishes. The 96-hr median lethal concentration (LC50) of the chemicals to rainbow trout (Salmo gairdneri) could be estimated from the 96 hr LC50 with fathead minnows (Pimephales promelas) with a correlation coefficient greater than 0.99. Equations for estimating the lethal concentration of chemicals with each species from the 98-hr LC50 for fathead minnows are presented. (Author's abstract)
W86-06156

TOXIC EFFECTS OF DISYSTON AND FURADAN ON THE BIMODAL PATTERN OF OXYGEN CONSUMPTION IN THE CLIMBING PERCH, ANABAS TESTUDINEUS (BLOCH),

Annamalai Univ., Annamalainagar (India). Dept. of Zoology.
R. Bakthavathsalam, and Y. S. Reddy.
Water Research WATRAG, Vol. 19, No. 9, p 1195-1198, 1985. 1 fig, 3 tab, 14 ref.

Descriptors: *Water pollution effects, *Pesticides, *Fish toxins, *Fish physiology, *Respiration, *Pesticide toxicity, Perch, Oxygen requirements, Ecological effects, Fish, Toxicity.

A significant change was noted in the aquatic (vO2), aerial (VO2) and total (v + V)O2 consumption of Anabas testudineus (Bloch) exposed to 4.0 and 10.5 mg/liter disyston and 0.56 and 1.56 mg/liter furadan. After 1 hr of exposure to all the concentrations significant decreases were noticed in the (v + V)O2. Though significant increases were noted in all the measures of respiration after 3 hr of exposure in both the pesticides, their effects vary from one exposure period to another. The fish held in 4.0 mg/liter disyston and 0.56 mg/liter furadan concentrations resumed a normal pattern of bimodal respiration after 120 and 96 hr respectively. Further the pattern of changes in (v + V)O2 closely followed the changes observed in VO2 rather than vO2 indicating that the fish held in pesticide medium predominantly relied on aerial respiration. A direct correlation was noticed between the VO2 consumption and the surfacing frequency of the fish exposed to disyston and furadan. Relatively furadan is more toxic than disyston to Anabas testudineus if their effects on O2 consumption are taken into consideration. (Author's abstract)
W86-06161

DISSOLVED ORGANIC CARBON OF COAL SLURRY TRANSPORT WATER,

Tennessee Univ., Knoxville. Dept. of Microbiology.
For primary bibliographic entry see Field 5B.
W86-06162

5D. Waste Treatment Processes

FLOCCULATION IN METHANOGENS, A COMPARATIVE STUDY OF METHANOSARCINA BARKERI STRAINS JULICH AND FUSARO,

Hamburg Univ. (Germany, F.R.). Inst. fuer Allgemeine Botanik.
For primary bibliographic entry see Field 5A.
W86-05422

WASTEWATER TREATMENT COSTS AND OUTLAYS IN ORGANIC PETROCHEMICALS: STANDARDS VERSUS TAXES WITH METHODOLOGY SUGGESTIONS FOR MARGINAL COST PRICING AND ANALYSIS,

Houston Univ., TX.
R. G. Thompson, and F. D. Singleton, Jr.
Water Resources Research WRERAO, Vol. 22, No. 4, p 467-474, April, 1986. 3 fig, 9 tab, 14 ref.

Descriptors: *Wastewater treatment, *Costs, *Chemical industry, *Petroleum products, Oil industry, Water pollution control, Organic compounds, Model studies, Water quality standards, Marginal costs, Texas, Standards, Taxes.

Comparable estimates of wastewater treatment costs and industry outlays are developed for effluent standard and effluent tax instruments for pollution abatement in five hypothetical organic petrochemicals (olefins) plants. The computational method uses a nonlinear simulation model for wastewater treatment to estimate the system state inputs for linear programming cost estimation. Focusing on best practical and best available technology standards, with effluent taxes adjusted to give nearly equal pollution discharges, shows that average daily costs (and the confidence intervals for treatment cost) would always be less for the effluent standard approach. However, industry's total outlay for these treatment costs, plus effluent taxes, would always be greater for the effluent tax approach than the total treatment costs would be for the effluent standard approach. Thus the practical necessity of showing smaller outlays as a prerequisite for a policy change toward efficiency dictates the need to link the economics at the microlevel with those of the macrolevel. Aggregation of the plants into a programming modeling basis for individual sectors and for the economy would provide a sound basis for effective policy reform, because the opportunity costs of the salient regulatory policies would be captured. (Cassar-PTT)
W86-05426

BASIC ENCODED MODEL FOR FLOW-THROUGH FIXED-BED ADSORBER AND ONE-DIMENSIONAL GROUND WATER SYSTEMS,

New Jersey Agricultural Experiment Station, New Brunswick.
For primary bibliographic entry see Field 5B.
W86-05465

EVALUATION OF STARTUP AND OPERATION OF FOUR ANAEROBIC PROCESSES TREATING A SYNTHETIC MEAT WASTE,

Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
T. Stephenson, and J. N. Lester.
Biotechnology and Bioengineering BIBIAU, Vol. 28, No. 3, p 372-380, March 1986. 8 fig, 3 tab, 39 ref.

Descriptors: *Continuous stirred tank reactors, *Anaerobic fuilized-bed reactors, *Meat processing industry, *Chemical oxygen demand, Hydrogen ion concentration, *Methanogenesis, *Wastewater treatment, Oxidation process, Fluidized bed process, Two-stage digestion.

Two continuous stirred tank reactors (CSTR) and four anaerobic fluidized-bed reactors (AFBR) were used to study the treatment of synthetic meat waste during one- and two-stage anaerobic treatment. Four configurations were investigated: a single-stage CSTR and AFBR and the two-stage systems CSTR-AFBR and AFBR-AFBR. Two-stage reactors removed up to 85% of the influent chemical oxygen demand (COD) concentrations of 5,000 mg/L, whereas the single-stage AFBR and CSTR removed 76 and 9%, respectively. The proportion of methane in the effluent gases increased as the influent COD concentration increased. Volumetric production of methane was greatest for the first stage of the AFBR-AFBR system. Solids retention times calculated for the AFBRs were 7-12 days, sufficient to support methanogenesis. The AFBRs and two-stage systems were more resistant to an influent pH shock from the operating value of pH 6.8 down to pH 3 than the CSTRs and single-stage reactors. It is concluded that high-rate AFBRs are applicable to meat industry wastewaters due to the rapid start-up possible, high rate of digestion methane production, and resistance to toxic shock. (Rochester-PTT)
W86-05477

TRACE ELEMENTS IN SEDIMENTS, WATER, AND AMERICAN COOTS (FULICA AMERICANA) AT A COAL-FIRED POWER PLANT IN TEXAS, 1979-1982,

Georgia Univ., Athens. School of Forest Resources.
For primary bibliographic entry see Field 5B.
W86-05479

SEWAGE TREATMENT: WHEN THE FEDERAL GOVERNMENT PULLS THE PLUG,

Water and Wastewater Equipment Mfrs. Association, Washington, DC.
For primary bibliographic entry see Field 6E.
W86-05509

EGYPT SEWERAGE FIX BEGINS TO TAKE HOLD,

M. Bennet, J. J. Kosowatz, and J. Birchall.
Engineering News Record, Vol. 216, No. 13, p 22-24, March 27, 1986.

Descriptors: *Sewer systems, *Egypt, *Funding, *Rehabilitation, Cairo, Alexandria, Port Said, Ismailia, Suez, Pumping stations, Ejector stations, Piping, Public opinion, Wastewater treatment facilities, Construction.

Various development projects aimed at correcting problems created by aging, deteriorated, and improperly run sewage treatment facilities in Egypt are described. the projects, designed by American and British engineers and funded by the United State Agency for International Development, the British Overseas Development Administration, and the Egyptian government, are in the cities of Cairo, Alexandria, Port Said, Ismailia, and Suez. The construction projects require rehabilitation of ejector stations, pumping stations, and piping, and building of miles of piping in unsewered areas. Difficulites encountered during these projects include settling in soft ground, having to work in highly congested old cities, shortages of currency, and criticism in the press. (Rochester-PTT)
W86-05510

HYDRAULIC BEHAVIOR OF DECLINING RATE FILTRATION,

Hidrosan Ltd., Bogata (Columbia).
J. Arboleda-Valencia, R. Giraldo, and H. Snel.
Journal of the American Water Works Association JAWWA5, Vol. 77, No. 2, p 67-74, December 1985. 15 fig, 12 ref.

Descriptors: *Declining rate filtration, *Hydraulics, Mathematical models, Wastewater treatment, Filtration, Design criteria, Head loss, Flow characteristics, Simulation, Water treatment.

One of the key difficulties in the practical application of declining rate filtration is the complexity of the hydraulic calculations used to predict the flows and levels in each filter unit. Equations for laminar head losses, turbulent head losses, and flow balance are presented. In order to generalize the equations to a system of n filtering units, certain assumptions were made. Once these assumptions are made, equations can be solved for a set of n filters. Previously published data were used to apply the simulation model to an experimental case. The simulation model closely predicted the behavior of one run at Medmenham (four pilot filters), both in the U.K. and one at Burham (four pilot filters). This means that the coefficients were accurate enough to analyze other filtration runs occurring under different circumstances. By using known hydraulic principles, it is possible to simulate the

functioning of variable declining-rate filters and assess the main design parameters. (Main-PTT)
W86-05515

COD REMOVAL RATES IN RBC SYSTEMS,

Rome Univ. (Italy). Dept. of Chemical Engineering.
A. E. Paolini.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 10, p 355-358, October 1985. 3 fig, 2 tab, 14 ref.

Descriptors: *Chemical oxygen demand, *Rotating biological contactor, Oxygen transfer, Organic loading, *Wastewater treatment, Biological wastewater treatment.

Previous studies on the rotating biological contactor (RBC) process demonstrated that substrate rate, in terms of mass of chemical oxygen demand (COD) or biological oxygen demand (BOD) removed per unit of effective disk surface area and time, increases with increasing organic loading rate, until a maximum value is approached when oxygen mass transfer becomes the rate-controlling factor. The primary objective of the present study was to correlate R sub m (maximum substrate removal) with both disk diameter and rotational speed. COD removal data were collected from six identical laboratory-scale RBC units, which were operated in parallel and rotated with different disk speeds. Synthetic wastewater was pumped to each RBC unit when its dissolved oxygen concentration was zero. The effluent from each unit flowed directly into the sewer through a sampling device. The soluble COD removal rate was calculated by using the average COD values of the influent and effluent from the RBC unit. Within the range of rotational speeds investigated, COD removal rate is virtually independent of rotational speed when applied organic loading is below 12 g soluble COD/d/sq m. The experimental COD removal rates at 30 rev/min did not appear to be limited by oxygen transfer. Within the whole range of rotational speed investigated, the performance of the bench-scale RBC unit is greatly limited by oxygen transfer. Under not-limiting oxygen transfer conditions, a hyperbolic function equation can be used to describe the effect of applied organic loading on soluble COD removal rates. Under limiting oxygen transfer conditions, the maximum COD removal rate is approximately a linear function of the square root of the disk rotational speed. The maximum removal rate in different size RBC systems is independent of disk diameter, when the disk peripheral velocity per unit specific surface area is used as a scale-up factor. (Main-PTT)
W86-05519

REVIEW OF THE BIOCHEMICAL OXIDATION OF SEWAGE,

T. Stones.
Effluent and Water Treatment Journal EWTJAG, Vol. 10, p 365, 367-369, October 1985. 7 tab, 17 ref.

Descriptors: *Wastewater treatment, *Biochemical oxidation, *Biological wastewater treatment, Phelps' Law, Biochemical oxygen demand, Kinetics, Dissolved oxygen.

The facts concerning the biochemical oxidation of sewage are reviewed with particular reference to the kinetics of the first stage of the process. Conclusive evidence shows that this does not proceed in accordance with a first order reaction as asserted in Phelps' Law, nor with the retarded modification thereof, but in conformity with a second order reaction that has a velocity coefficient of 0.039 at 20 C and during the course of which the rate of oxidation at any instant is governed conjointly by the unsatisfied carbonaceous biochemical oxygen demand and the residual dissolved oxygen concentration. As oxidation proceeds, its rate decreases in keeping with the attributes of such a reaction and has been correlated with the effect of the rates of oxidation pertaining at the times when measurements were made of residual oxygen. A method has been devised for the practical determination of the first stage biochemical oxygen demand of a sewage from measurements of the amount of dissolved oxygen initially present in a suitable dilution and the amounts absorbed after any three consecutive days at the standard temperature of 20 C. (Main-PTT)
W86-05520

CENTRALISED METAL RECOVERY FROM METAL FINISHING WASTES,

Warren Spring Lab., Stevenage (England).
D. Pearson, and J. Melling.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 11, p 387-390, November 1985. 1 fig, 2 tab, 13 ref.

Descriptors: *Metal recovery, *Wastewater treatment, *Metal finishing wastes, Precipitation, Ion Exchange, Solvent extraction, Evaporation, Electrolysis, Sludge.

In the production of electroplated articles, 10-90% of the plating metals are discharged in the form of effluents rather than being deposited on the work pieces. Processes for effluent treatment produce a metal-bearing sludge which is rarely suitable for metals recovery, and may represent a pollution hazard. In this paper the methods of treatment available for use by the metal finisher are reviewed (precipitation processes, ion exchange and solvent extraction, evaporation, electrolysis, and membrane processes). Methods for the recovery of metals from the sludges produced are also described. While technology that minimizes loss of toxic metals to the environment is available, implementation will require concerted action by all those involved, the waste producers, disposal authorities, water authorities and companies carrying out metal recovery. (Author's abstract)
W86-05522

MALAYSIAN STUDIES OF RECALCITRANT DETERGENT WASTEWATER,

Malaya Univ., Kuala Lumpur (Malaysia).
M. A. Hashim, R. R. Hassan, and J. Kulandai.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 11, p 391-393, November 1985. 2 fig, 4 tab, 17 ref.

Descriptors: *Wastewater treatment, *Detergents, *Flocculation, Coagulation, Alum, Lime, Precipitation, Chemical oxygen demand, Turbidity, Suspended solids, Coagulation, Hydrogen ion concentration.

Optimal coagulants and conditions for the treatment of recalcitrant detergent wastewater were investigated. Wastewater was obtained from a local detergent plant manufacturing toiletries and detergents. Flocculation studies were carried out using commercial grade alum and lime. The wastewater and the coagulants(s) were flash mixed. The solution was allowed to flocculate for 10 min at 40 rmp and then settle. Flocculation was monitored visually using a previously devised points system. Chemical oxygen demand, biological oxygen demand, total suspended solids (TSS), turbidity and phosphate content were analyzed. The optimal dosages of lime and alum added singularly and in combination to effect optimal reduction in turbidity and TSS were 1100mg/l and 2200mg/l, respectively. The use of lime and alum as single coagulants were less effective than when used in combination. Maximum removal of turbidity occurred at pH 3 or less. Alum flocculation was comparatively ineffective in turbidity and TSS reductions. It is believed that precipitation, coagulation and flocculation were at work in the chemical treatment of the detergent wastewater under consideration. (Main-PTT)
W86-05523

TREATMENT OF AN INDIAN DISTILLERY WASTEWATER,

Tamil Nadu Water Supply and Drainage Board, Madras (India).
T. D. Rao, and T. Viraraghavan.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 11, p 394-396, November 1985. 1 tab, 17 ref.

Descriptors: *Distillery wastewater, *Wastewater treatment, Byproduct recovery, Anaerobic lagoons, Anaerobic digestion, Anaerobic filters.

There are 141 distilleries working in India processing approximately 2.2 million tonnes of molasses producing about 500 million litres of alcohol. The liquid wastes from the process mainly consist of spent wash, yeast waste sludge and floor washing. This paper discusses the methods investigated, adopted and proposed for the treatment of distillery spent wash in India. Treatment options include: anaerobic digestion, byproduct recovery, anaerobic lagoons, anaerobic filters, and full scale lagoons. The anaerobic lagoon systems as used in India suffer from the handicaps of lack of facilities for biogas collection and odor control; this situation can be set right by providing well engineered bulk fermenter systems of earthen construction designed with a membrane cover for biogas collection and odor control. (Main-PTT)
W86-05524

COMPUTER-AIDED SIMULATION OF AN ACTIVATED SLUDGE REACTOR,

Roorkee Univ. (India). Dept. of Civil Engineering.
S. K. Gupta.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 11, p 402-405, November 1985. 5 fig, 2 tab, 7 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Mathematical models, Computer programs, Continuous system modelling, Biological oxygen demand, Sludge, Kinetics.

A number of mathematical models are available covering a large range of activated sludge (AS) reactors. However, these models are either too simple or too intricate and require many separate investigations for estimation of kinetic constants. An attempt was made to test the simple mathematical model proposed by Herbert on a full-scale reactor at Blyth water pollution control works in the United Kingdom. Cell and substrate concentration balance equations across each reactor were formulated. Samples of settled sewage, mixed liquor from each of the four reactors and the returned sludge were collected every 40 minutes, and analyzed for solids concentration. The settled sewage samples and the mixed liquor filtrates were also analyzed for biological oxygen demand (BOD). Implementation of model equations was accomplished by the use of a (CSMP) continuous system modelling program. The maximum deviation between the model and the observed results in solid concentration cases varied between 5.5 to 13.7% of the model values. Maximum durations up to 46% from the observed BOD values were recorded. Based on the results, the following conclusions may be derived: CSMP techniques are a strong tool to work out the dynamic solution of complex mathematical equations involved in modelling an ASP reactor; the Herbert model is a good predictor of the transient loading response of a full scale ASP; and data at water pollution control works should be collected at closer intervals to yield better results. (Main-PTT)
W86-05525

WET AIR OXIDATION OF HAZARDOUS ORGANICS IN WASTEWATER,

Zimpro, Inc., Rothschild, WI.
M. J. Dietrich, T. L. Randall, and P. J. Canney.
Environmental Progress ENVPDI, Vol. 4, No. 3, p 171-177, August 1985. 1 fig, 15 tab, 9 ref.

Descriptors: *Wet air oxidation, *Organic compounds, *Hazardous wastes, *Wastewater treatment, Ozonation, Aromatic compounds, Chemical reactions, Pesticides, Industrial wastewater.

An established technology proven to be effective for the destruction of a wide variety of hazardous organics contained in wastewater is Wet Air Oxidation (WAO). Bench-scale studies were performed using batch autoclaves constructed of stainless steel, nickel or titanium. Autoclaves were charged with the sample to be oxidized, sealed, charged with air or oxygen, and placed in a heater/shaker mechanism. In acute toxicity tests there have been 15 to 4000-fold reductions in the toxicity of solutions of a number of pure compounds following WAO. Phenol reductions of

greater than 99.9% were achieved with WAO/ozone treatment. A number of bench-scale WAO studies were performed on industrial wastewaters and the fate of specific organic compounds were evaluated. Results of specific compound analyses generally agree with the conclusions drawn from WAO of pure compounds. These results seem to indicate that the presence of electron withdrawing groups on aromatic rings provides stability, and therefore resistance, to WAO. Electron donating constituents appear to make aromatic rings more susceptible to destruction by WAO. Wastewater generated by a solvent recovery process was subjected to wet oxidation, resulting in excellent removal with the exception of methanol, for a variety of low molecular weight solvents. Several WAO studies performed on wastewaters generated in the production of nonchlorinated pesticides indicated these classes of compounds were very amenable to WAO. Pilot-scale, continuous flow WAO studies have been performed on a number of industrial wastewaters. The wet oxidation of wastes containing a number of hazardous organic compounds has been demonstrated on a full-scale basis as well. Bench, pilot, and full-scale performance data have indicated that WAO can be very effective in treating toxic and hazardous industrial wastewaters. (Main-PTT)
W86-05530

SELF-CLEANING SLOPE FOR PARTIALLY FULL SEWERS,

Rose-Hulman Inst. of Tech., Terre Haute, IN. Civil and Mechanical Engineering Div.
For primary bibliographic entry see Field 8B.
W86-05535

OZONE AND BIOLOGICAL TREATMENTS - EFFECTS ON THE ELIMINATION OF CYANIDES,

Service de Controle des Eaux de la Ville de Paris (France).
A. Montiel, and J. Ouvrard.
Ozone Science & Engineering OZSEDS, Vol. 7, No. 2, p 85-92, Spring 1985. 1 fig, 2 tab, 9 ref.

Descriptors: *Ozone, *Cyanides, *Biodegradation, *Wastewater treatment, Biological wastewater treatment, Drinking water, Ammonium, Bacteria, Ozonation, Ozone, Stress analysis, Colorimetry.

Since previous publications concerning the effect of ozone on biological treatments are contradictory, increasing biodegradation on the one hand, effect of 'stress' on bacteria on the other, the authors have selected two compounds which are eliminated only by biodegradation: cyanides and ammonium ions. The pilot plant for the study is comprised of two treatments in series: clarification and ozonation chambers. Following this stage was a biological treatment. Raw water was mixed with potassium cyanide and ammonium. Determination of cyanides and ammonium ions were made according to standard colorimetric methods. This study has shown that ozone retards cyanide and ammonium ion biodegradation significantly. There appears to be two competitive actions concerning the elimination of organic materials: an increase in the possiblity of biodegradation and the effect of 'stress' on bacteria. The result of these actions is in favor of ozone. (Main-PTT)
W86-05539

UTILIZATION OF OZONE FOR THE TREATMENT OF RECYCLEABLE PAPERS,

Norwegian Pulp and Paper Research Inst., Oslo.
F. A. Abadie-Maumert, and N. Soteland.
Ozone Science and Engineering OZSEDS, Vol. 7, No. 3, p 229-239, Summer 1985. 4 tab, 9 ref.

Descriptors: *Ozonation, *Recyclable papers, *Pulp wastes, *Recycling, Bleaching, Cost-benefit analysis, Norway, England, Waste treatment.

Ozonation is being considered for improving recyclable paper pulps by the British Research Association of the Paper Board, Printing and Packaging Industries, and two institutions which have studied the problem of ozonation of pulps of recycleable paper (the Institute of Paper Chemistry (IPC) in the U.S., and Paper Industriens Forskningsinstitutt (PFI), in Norway.) In certain cases, treatment by ozone of recycled paper pulps can lead to specific improvement of certain mechanical properties or of the whiteness of these pulps, without increasing the pollution. However, results are difficult to predict if the exact composition of the pulp is unknown. In many cases, classical mechanical refining allows obtaining, at a better price, the same increase in mechanical properties of a recycled paper containing a mechanical pulp after ozonation. If the paper is based on chemical pulp, ozonation is. Nevertheless, as shown in the United States IPA studies, for certain qualities of well defined recyclable papers, the economic gain for a treatment of recycled paper pulps is indisputable. (Main-PTT)
W86-05540

PRETREATMENT STANDARDS FOR HAZARDOUS WASTES,

D. Schauer.
Biocycle BCYCDK, Vol. 27, No. 5, p 45-47, May-June 1986. 1 fig.

Descriptors: *Domestic sewage study, *Wastewater treatment, *Resource Recovery and Conservation Act, *Pretreatment, *Hazardous materials, Publicly-owned treatment works, Water pollution, Air pollution, Sludge contamination, Clean Water Act, Clean Air Act, Comprehensive Environmental Response, Compensation and Liability Act, Standards, Environmental Protection Agency, United States, Occupational safety and health, Groundwater pollution.

Results of the U.S. Environmental Protection Agency Domestic Sewage Study are summarized under the following headings: Resource Recovery and Conservation Act (RCRA) vs pretreatment, pretreatment program, environmental concerns (water pollution, sludge contamination, air pollution, worker health and safety, overall publicly-owned treatment works (POTW) operation, and groundwater pollution), study methods, and discharge data (overview of sources, types, and quantities, nonpriority RCRA constituents, solvents and other common organics, pollutant fate within POTWs, hazardous waste discharges, and adequacy of existing governmental controls), and recommendations. Four recommendations for improving controls on hazardous waste discharges to sewers have been derived from the findings of the DSS: (1) additional research, data collection, and analysis are necessary to fill information gaps; (2) improvements can be made to federal categorical standards and local pretreatment controls to enhance control of hazardous wastes discharged to sewers; (3) EPA should emphasize improvement of controls on hazardous wastes through ongoing implementation of water programs; and (4) RCRA, Comprehensive Environmental Response, Compensation, and Liability Act should be considered along with the Clean Water Act to control hazardous waste discharges and/or receiving POTWs if the recommended additional studies indicate problems. (Rochester-PTT)
W86-05545

DETERMINATION OF REQUIREMENTS FOR SANITATION FACILITIES AT LARGE GATHERINGS,

Missouri Univ.-St. Louis.
L. D. Smith, P. G. Marlin, and C. R. Kuehl.
Journal of Environmental Health JEVHAH, Vol. 48, No. 5, p 250-258, March-April 1986. 3 fig, 6 tab, 4 ref, 3 append.

Descriptors: *Sanitation, *Microcomputers, *Sanitation tanks, *Toilets, *Crowds, Management planning.

Provision of adequate sanitation facilities for large gatherings of people is a problem of considerable analytical complexity. In addition to factors such as crowd size and duration of the event, determination of requirements should involve consideration of waiting lines that develop in peak periods of use, waste capacity of toilets (if limited by holding tanks), duration of visits at the event, and layout of activity centers and sanitation facilities on the grounds. This paper describes analytical procedures for consideration of these factors and demonstrates the use of tables of microcomputer software that have been created to help practitioners determine the best arrangement of facilities. (Author's Abstract-PTT)
W86-05548

SEPTIC TANK EFFLUENT TREATMENT USING AN ANAEROBIC FILTER,

Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Viraraghavan, and R. J. Kent.
Canadian Journal of Public Health CJPEA4, Vol. 77, No. 1, p 51-54, Jan/Feb 1986. 2 fig, 6 refs.

Descriptors: *Anaerobic filter treatment, *Septic tanks, *Canada, *Cold regions, Biochemical oxygen demand, Suspended solids, Tile fields, Regulations, Waste treatment facilities.

The suitablility of anaerobic filter treatment of septic tank effluent for Canadian conditions is assessed. The reactions of provincial health/environmental agencies on this system as determined from responses to a questionnaire are included. This method appears to a suitable treatment step under Canadian conditions, especially to reduce biochemical oxygen demand (BOD) and suspended solids (SS) levels in effluent discharged for disposal through the tile field system. It is believed that regulations would permit use of such a system on an experimental basis in most provinces. In Canada, BOD removals through the anaerobic filter are expected to be much lower during colder months. Laboratory studies under low temperature and long-term field studies are needed to assess the potential of anaerobic filter treatment more realistically. (Rochester-PTT)
W86-05566

SIMULTANEOUS MULTI-INSTRUMENTAL MONITORING OF VAPORS IN SEWER HEADSPACES BY SEVERAL DIRECT-READING INSTRUMENTS,

Cincinnati Univ. Medical Center, OH. Inst. of Environmental Health.
For primary bibliographic entry see Field 5A.
W86-05572

NOTE ON THE FEASIBILITY OF DEGRADATION OF PHENOL BY SOME CRUSTACEAN LARVAE,

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
S. V. R. Rao.
International Journal of Environment Studies IJEVAW, Vol. 24, No. 3/4, p 273-275, May 1985. 5 tab, 3 ref.

Descriptors: *Phenols, *Freshwater crustacea, *Wastewater treatment, Canthocamptus spp, Daphnia ssp, Bosmina spp, Synthetic culture medium, Cost analysis, Animal physiology.

Three freshwater crustacean larvae (Canthocamptus spp, Daphnia spp, and Bosmina spp) were cultured in synthetic medium and were shown to selectively degrade phenol, a common constituent of industrial waste discharges. The prospects of obtaining a low-cost treatment system for replacing conventional methods for phenol-containing waste waters look very promising. Though the proposed treatment is effective, care must be taken to dilute wastes before treatment with larvae. (Author's Abstract)
W86-05580

ENTROPY ANALYSIS OF WATER AND WASTEWATER TREATMENT PROCESSES,

National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
S. Tai, and T. Goda.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 1/2, p 13-21, June 1985. 3 fig, 3 tab, 3 ref.

Descriptors: *Entropy, *Thermodynamic efficiency, *Pollutants, *Dispersion, *Wastewater treatment, Systems engineering, Energy, Water treatment.

Water in the environment, due to its physicochemical properties, such as its action as a solvent and its use as a carrier of waste materials and waste heat, is very susceptible to pollution. Entropy, the measure of disorder of a system, can be used to study pollution. For example, if a compound is dumped in pure water, it is likely that the compound will be dissolved and diffused into the water body. The meaning of this solution and diffusion in the water is two-fold: (1) increase in entropy of the solution and (2) increase in the extent of pollution. It can be seen that an increase in entropy can describe water pollution; thus, once water is polluted, input energy is required to remove the pollutants and purify the water, which decreases the entropy and reduces the pollution. If the efficiency of a water treatment system can be given by entropy production, then the thermodynamic efficiency of water treatment systems can be evaluated. (Rochester-Ptt)
W86-05582

TREATMENT OF WATER CLOSET FLUSH WATER FOR RECYCLE AND REUSE,

Texas Univ. at Arlington. Dept. of Civil Engineering.
C. E. Parker.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 1/2, p 87-108, June 1985. 9 fig, 9 tab, 4 ref.

Descriptors: *Biological oxidation, *Sand filters, *Aeration, *Water closet flush water, *Water reuse, Hydrogen ion concentration, Suspended solids, Fungi, Flushing, Wastewater treatment facilities.

Results of the operation of a 37.8 cu m/day extended aeration and sand filtration system in a closed-loop treatment of water closet flush water are presented. The system was operated for 4.5 yr at 95% recycle. Water inputs into the recycle system resulted from liquid human wastes plus wastage from potable water uses. Wasted potable water inputs were from wash basins, water fountains, and custodial services. Chemicals were not required to adjust pH, aid solids settleability, or enhance treatment efficiency. The pH throughout the entire recycle system varied between 5.5 and 8.4. Recycled water pH rose from a preflush pH of approx 7.0 to a pH of 8.4 immediately after flushing. The biological unit lowered the pH and functioned between pH values of 5.5 and 7.0. A slight rise in pH between the biological unit (through storage and filtration) and water closets was observed. The predominant biomass in the biological unit was fungi. Wastage of biological solids from the biological unit in the recycle-reuse system was the same as experienced for a comparable biological unit used to treat water closet wastewater that was not recycled. The present results demonstrate conclusively, on a full-scale basis, the acceptability of using biological oxidation and sand filtration as a treatment train in the reuse of water closet wastewater with a recycle ratio of 20. (Rochester-PTT)
W86-05585

ATTENUATION OF HEAVY METAL TOXICITY OF THE ACTIVATED SLUDGE PROCESS BY TREATMENT WITH FERRIC CHLORIDE,

Texas Univ. at Arlington. Dept. of Civil Engineering.
F. J. Gaudet, and S. R. Qasim.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 1/2, p 127-135, June 1985. 3 fig, 4 tab, 9 ref.

Descriptors: *Activated sludge process, *Ferric chloride, *Heavy metals, *Toxicity, *Acclimatization, *Microorganisms, *Wastewater treatment, Silver, Lead, Kinetics, Respiration.

Laboratory experiments were conducted to examine the use of ferric chloride acclimation for treatment against heavy metal toxicity of an activated sludge process. The oxygen uptake of acclimated and unacclimated microbial seed was measured by respirometry to determine the inhibitory effects of Ag and Pb. The toxic effects of Ag and Pb were greatly reduced for acclimated seed. The experimental data are used in kinetic rate equations and families of curves are developed to show the inhibition of Ag and Pb at a range of concentrations when the activated sludge is acclimatized at different concentrations of Fe(III). (Author's abstract)
W86-05586

PLANNING, DESIGN AND CONSTRUCTION OF THE GREAT GRIMSBY SEWAGE OUTFALL,

Anglian Water Authority, Lincoln (England). Lincoln Div.
For primary bibliographic entry see Field 8A.
W86-05593

OXYGEN ISOTOPE RATIOS IN N2O FROM NITRIFICATION AT A WASTEWATER TREATMENT FACILITY,

New York State Dept. of Health, Albany. Wadsworth Center for Labs. and Research.
T. Yoshinari, and M. Wahlen.
Nature NATUAS, Vol. 317, No. 6035, p 349-350, 26 September 1985. 2 fig, 2 tab, 21 ref.

Descriptors: *Oxygen isotope ratios, *Nitrification, *Wastewater treatment, Isotope fractionation, Denitrification, Ozone, Nitrogen compounds, Nitrogen cycle.

Atmospheric N2O plays an important part in the destruction of ozone in the stratosphere. N2O formed by nitrification and denitrification have been considered but the strengths of different sources and sinks of N2O for a global budget have yet to be successfully assessed. This is mainly because the number of measurements and the areal coverage have been limited. Results presented in this study suggest that N20 from nitrification has a delta-180 of about 22 ppt, which is substantially lower than 45 ppt for N20 in the atmosphere. If N20 from nitrification is indeed a significant source for atmospheric N20, a source of isotopically heavier N20, possibly from denitrification is required to balance the atmospheric N2(18)0. N20 from the oceans, which at the oxygen minimum layer is thought to be derived from nitrification, could have a slightly higher delta - 180 because dissolved 02 and ocean water are somewhat heavier in delta-180 than atmospheric 02 and meteoric water. (Khumbatta-PTT)
W86-05600

REDOX POTENTIAL - BASIS OF MEASUREMENT AND APPLICATION,

New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. Barnes, P. FitzGerald, R. McFarland, H. Swan, and T. Schulz.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No.7, p 232-236, July 1985. 8 fig, 1 tab, 9 ref. NSW State Pollution Control Funding.

Descriptors: *Redox Potential, *Wastewater Treatment, Piggery wastewater, Malodourous Compounds.

Redox potential has considerable attraction as a control parameter for wastewater treatment processes. It measures the ratio of oxidized to reduced material in a sample. It can provide a criterion upon which to control the conditions within a reactor. In general reducing anaerobic conditions tend to produce malodourous compounds. Hence redox potential has an application to minimize odor emissions from wastewater treatment plants. This paper attempts to explain in simple terms the basis of redox potential theory and measurement. Studies on the odors from the treatment of piggery wastewater indicates that the breakthrough of odor occurs at a redox potential which is more negative than that which occurs when the dissolved oxygen concentration becomes zero. There is a range of redox potentials over which aerobic conditions are established or lost. However, the redox potential at which odor breakthrough will occur is dependent upon the individual as a guide because after a lag period, the redox potential decreases rapidly under conditions of underaeration. Therefore, the selection of a particular redox potential to indicate odor breakthrough is prone to error. (Khumbatta-PTT)
W86-05601

INTEGRATED BIOLOGICAL/CHEMICAL WASTEWATER TREATMENT,

Benin Univ., Benin City (Nigeria). Centre for Social, Cultural and Environmental Research.
C. Ademoroti.
Effluent and Water Treatment Journal EWTJAG, Vol.25, No.7, p 237-241, July 1985. 1 fig, 5 tab, 18 ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, Chemical wastewater treatment, Sewage, Biodegradation, Activated sludge, Oxidation, Aerated lagoons, Chemical treatment.

Biological methods (trickling filtration, activated sludge, oxidation ditch/pond, aerated lagoon) are most widely adopted for treating wastewater. The use of these methods involves the oxidation of biodegradable wastes in water by bacterial action. These methods yield fairly good effluents but they have their drawbacks. Nitrates and phosphates are not well reduced and are known to create the problem of eutrophication in water bodies. Nitrates have been found to increase in trickling filtration and surface aerated activated sludge treatments, and are known to cause methemoglobinemea in infants. Recent research interests have been shown in the use of chemical methods for wastewater treatment. Although these methods have produced better effluents than the biological methods, the integration of the two methods appears to give a superior result than either alone can produce. the final effluent, from the integrated biological/chemical treatment, was of a quality comparable with World Health Organization standards. (Khumbatta-PTT)
W86-05602

ADVANCED SUBTERRANEAN WASTEWATER TREATMENT PLANT,

Hollandse Eilandenen Waarden Wastewater Authority, Dordrecht (Netherlands).
A. W. Van der Vlies, and W. G. Werumeus Buning.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 7, p 253-257, July 1985. 3 fig, 3 tab, 3 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Subterranean wastewater facilities, Rotterdam, Groundwater, Water pollution control, Municipal wastewater.

The pollution abatement of surface waters in the Rotterdam area has been studied over a number of years. Rotterdam has one of the biggest harbors in the world. To achieve a definitive solution to the water quality problem in this area, a wastewater treatment plant at Dokhaven will be realized, with three municipal wastewater treatment plants and several industrial plants to be built for the treatment of the sewage water of the Rotterdam area. Although a sewage treatment plant in the midst of a housing estate seems contrary to modern planning but economics makes the location necessary. To prevent environmental problems, it was decided to build a completely subterranean plant covered with a public park. The physical design for this subterranean plant is presented in this paper, as are the process description, the ventilation system, and the air purification system. (Khumbatta-PTT)
W86-05603

ANAEROBIC TREATMENT OF ALCOHOL PRODUCTION WASTES,

Birmingham Univ. (England). Dept. of Civil Engineering.
T. H. Y. Tebbutt, and W. A. Nogueira.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 8, p 277-278, 280-281, 283, August 1985. 18 fig, 15 ref.

Descriptors: *Wastewater treatment, *Alcohols, *Industrial wastes, *Anaerobic treatment, Biological treatment, Biodegradation, Chemical oxygen demand, Brazil, Volatile acids, Alkalinity.

Anaerobic processes have a long history in the treatment of municipal wastewater sludges, and the treatment of strong industrial wastewaters. Since there has been only limited coverage of the application of anaerobic systems to the stabilization of actual wastewaters this paper reports on a preliminary study into the possible benefits of using anaerobic treatment to deal with wastes resulting from the production of alcohol from vegetable materials. These wastes are of particular significance in Brazil where alcohol production for use in motor vehicles is planned to increase drastically. The problem is exacerbated because most of the alcohol production is concentrated in a relatively small area of the country which has a high population density and in which the rivers are already suffering from pollution. Preliminary studies have shown that simple anaerobic reactors can achieve COD removals of 40-60% from strong molasses wastes, depending upon the loadings used. the units operated at high removal rates at loadings of up to 16 kg COD/cu m/d, and gas production in terms of cu m/kg COD removed was not greatly affected by loading except at low loadings below about 2 kg COD/cu m/d. Volatile acids concentration alone did not appear to have much significance on the system behavior, but the ratio of volatile acids/alkalinity was highly significant with respect to COD percentage removal. (Khumbatta-PTT)
W86-05605

EFFICIENCY OF O3 AND BAC IN THMS REMOVAL,

Harbin Civil Engineering Inst. (China). Water Pollution Control Lab.
B. Wang, J. Yin, J. Tian, Q. Fan, and R. Liu.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 8, p 291-293, 295-298, August 1985. 8 fig, 1 tab, 16 ref.

Descriptors: *Trihalomethanes, *Wastewater treatment, *Ozonation, Activated carbon, Organic compounds, Microorganisms, Pretreatment of water, Chloroform.

Ozonation together with biological activated carbon is very effective in removing a wide variety of organic pollutants from source water due to various removal mechanisms such as ozonolysis, physical adsorption and the biological activity in a granular activated carbon (GAC) bed. Preozonation degrades part of the organic compound into gaseous end products and provides the microorganisms grown in an activated carbon (AC) bed with nutrient substances and sufficient oxygen, thus resulting in the vigorous growth of the microorganisms. It was found in this study that prechlorination increased the chloroform content level markedly over the original level, particularly when the raw water contained precursors with high chloroform production ratios, such as phenol, significantly immediately after ozonation, but then increased again steeply with time. After 12-24 hr retention, the ozonated water increased in chloroform content many times over the chlorinated water. Neither ozonation nor GAC bed process is effective in remaining chloroform and other trihalomethanes, and can increase it. (Khumbatta-PTT)
W86-05606

CELLULAR RETENTION TIME IN THE ACTIVATED SLUDGE PROCESS AT NON-STEADY FLOW,

Santander Univ. (Spain). Dept. of Sanitary Engineering.
R. C. Lara.
Effluent And Water Treatment Journal EWTJAG, Vol. 25, No. 9, p 315-320, September 1985. 5 fig, 12 ref.

Descriptors: *Wastewater treatment, *Cellular retention time, *Activated sludge process, *Nonuniform flow, *Uniform flow, Microorganisms, Mathematical analysis, Mathematical equations, Wastewater treatment, Kinetics.

The cellular retention time or sludge age constitutes a basic parameter concerning the knowledge and control of an activated sludge process, actually known as the uniform flow. In this work, the cellular retention time is mathematically defined as a non-steady flow, regardless of any variations that may be present. A series of hypothesis are established to deduct a mathematical expression able to determine the expression of microorganism concentration each time, x, as concerns cellular retention time, theta x, at non-uniform flow. From the evaluation of geometric and contaminating parameters, sludge characteristics, exploitation characteristics, and duration of water cutting in the process, the following conclusions were made: 1) the cutting of the influent in a wastewater plant, causes a fall in the microorganism concentration of the mixing liquid as well as an increment in the sludge age; 2) the influence of the constants y, k, and k subs is practically rejected in the relative increments of x and theta x, whenever an influent's cutting is produced; and 3) for typical biokinetic valves, and 1 day cutting duration, relative increments in x higher than 10% are not produced. Theta x can get as high as 40%. (Khumbatta-PTT)
W86-05608

POTABLE GROUNDWATER SUPPLIES AND LOW-COST SANITARY ENGINEERING: HOW COMPATIBLE,

Institute of Geological Sciences, Wallingford (England). Hydrogeology Unit.
For primary bibliographic entry see Field 5G.
W86-05719

DESIGN MANUAL: NEUTRALIZATION OF ACID MINE DRAINAGE,

Penn Environmental Consultants, Inc., Pittsburgh, PA.
E. D. Escher, A. J. Kicinski, and R. M. Ninesteel.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-170654, Price codes: A13 in paper copy, A01 in microfiche. EPA-600/2-83-001, January 1983. 231 p, 40 fig, 32 tab, 112 ref, 1 append.

Descriptors: *Wastewater treatment, *Water pollution control, *Acid mine drainage, *Neutralization, *Mine drainage, Lime, Reverse osmosis, Ion exchange, Calcium hydroxide, Dewatering, Sludge, Water softening, Sludge disposal, Iron, Oxidation, Costs, Sedimentation, Mixing, Chemical wastewater treatment, Sodium hydroxide, Soda ash.

This manual is designed to help designers and operators of mine drainage treatment plants select processes, equipment, and procedures. Popular neutralizing agents are reviewed. These include lime, limestone, caustic soda, and soda ash. The engineering processes such as mixing, iron oxidation, sedimentation, sludge dewatering and disposal, electrical equipment, reverse osmosis, ion exchange, and chemical softening are described. Two examples of treatment facility designs are given. The manual also presents a cost estimating section with examples based on the two designs. A general cost curve is given to allow rapid estimating of treatment facilities based on flow. (See also W86-05750) (Cassar-PTT)
W86-05789

TREATMENT PLANT HYDRAULICS FOR ENVIRONMENTAL ENGINEERS,

Auburn Univ., AL.
L. D. Benefield, J. F. Judkins, and A. D. Parr.
Prentice-hall, Inc., Englewood Cliffs, NJ 07632. 231 p.

Descriptors: *Wastewater treatment, *Hydraulics, *Water treatment, *Flow, Pipes, Outfalls, Open channel flow, Uniform flow, Varied flow, Pipe flow, Head loss, Flow measurement, Weirs, Flumes, Pumps, Activated sludge process, Primary wastewater treatment, Biological wastewater treatment, Clarifiers, Aeration, Chlorination.

A book on hydraulic design of water and wastewater treatment facilities begins with a review of hydraulic fundamentals, emphasizing components and situations commonly encountered in treatment plant design. These review topics include flow in pipes (conservation laws, friction, losses, sludge flow, and flow division), multiport diffuser outfalls, open channel flow, flow measurement and hydraulic control points, and pumps. A step-by-step example of the hydraulic design of an activated sludge treatment plant illustrates the importance of hydraulic control points in plant design and shows that the units must operate compatibly to provide the desired flow profile. The example does not attempt to optimize treatment plant hydraulic, but uses a variety of conditions found in typical plants. (Cassar-PTT)
W86-05793

COSTS ESTIMATES FOR CONTROL OF COMBINED SEWER DISCHARGE TO MARINE BAYS AND ESTUARIES, ADDENDUM TO 1982 NEEDS SURVEY.

Environmental Protection Agency, Washington, DC. Office of Water Program Operations.
For primary bibliographic entry see Field 5G.
W86-05797

ON-LINE LIQUID-EFFLUENT MONITORING OF SEWAGE AT LAWRENCE LIVERMORE NATIONAL LABORATORY,

Lawrence Livermore National Lab., CA.
M. Dreicer, J. L. Cate, D. W. Rueppel, C. J. Huntziner, and M. A. Gonzalez.
Available from the National Technical Information Service, Springfield, VA. 22161, Price codes: A02 in paper, A01 in microfiche. Report No. UCRL--88425, December 2, 1982. 9p, 1 tab, 3 ref. Contract No. W-7405-ENG-48.

Descriptors: *Effluent streams, *Wastewater, *Wastewater treatment, *Monitoring, *Lawrence Livermore National Laboratory, Industrial wastewater, Hydrogen ion concentration, Radiation, Trace metals, Radiometry, X-ray fluorescence.

On-line effluent monitoring is important to prevent releases of potentially toxic material to the environment. At Lawrence Livermore National Laboratory (LLNL) the sewage leaving the laboratory is treated by the Livermore Water Reclamation Plant (LWRP). The laboratory has the responsibility to protect the reclamation plant and local environment from the accidental discharge of toxic materials into the sewers. An automatic on-line sewage effluent monitoring system has been developed at LLNL. A representative fraction of the total waste stream leaving the site is monitored for pH, radiation, and metals as it passes through a detection assembly. This assembly consists of an industrial pH probe, NaI radiation detectors, and an x-ray fluorescence metal detector. A microprocessor collects, reduces and analyzes the data to determine if the levels are acceptable by established environmental limits. Currently, if preset levels are exceeded, a sample of the suspect sewage is automatically collected for further analysis, and an alarm is sent to a station where personnel can be alerted to respond on a 24-hour basis. Since at least four hours pass before LLNL effluent reaches the treatment plant, sufficient time is available to alert emergency personnel, evaluate the situation, and if necessary arrange for diversion of the material to emergency holding basins at the treatment plant. (Author's abstract)
W86-05799

WATER REUSE: PROBLEMS AND SOLUTIONS,

R. B. Dean, and E. Lund.
Academic Press, London, England. 1981. 264 p.

Descriptors: *Water reuse, *Wastewater renovation, *Municipal water, *Water quality control, *Water quality management, Wastewater treatment, Microbiological studies, Sanitary engineering, Public health, Public opinion, Potable water.

The reuse of wastewater for potable purposes has been the subject of many discussions, although the majority of publications on the subject are con-

cerned only with direct internal reuse in which a city's sewage becomes part of its own water supply. Relatively little attention has been paid to the large number of communities that depend on surface water containing sewage. These communities employ treatment processes that meet the criteria designed to protect public health, and they do not appear to suffer from this reuse. This book reviews the basic problems of water supply with special emphasis on the specific pollutants that seem to pose the greatest risk. It presents the treatment processes which are, or may be, employed to reduce pollutants in wastewater to acceptable levels, and discusses their capabilities and limitations. The emphasis is on municipal water systems which may contain varying fractions of reused water. The book is designed as a multidisciplinary approach to the problems of water reuse, including topics in microbiology, chemistry, sanitary engineering, public health, epidemiology, economics, and public opinion. (Lantz-PTT)
W86-05800

SAN FRANCISCO'S WASTEWATER TREATMENT PROGRAM NEEDS REEXAMINATION AND BETTER MANAGEMENT.

General Accounting Office, Washington, DC. Mission Analysis and Systems and Acquisition Div.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-171025, Price codes: A02 in paper copy, A01 in microfiche. Report No. GAO/MASAD-83-11, February 1, 1983. 21 p.

Descriptors: *San Francisco, *California, *Wastewater treatment, *Cost-benefit analysis, *Wastewater management, Wastewater Treatment Program, Water pollution, Cost analysis, Project planning, Funding, Cost effectiveness.

When the initial phase of San Francisco's $3 billion Wastewater Treatment Program becomes operational, it should significantly reduce the pollution of the San Francisco Bay and Pacific Ocean. However, increased benefits to be gained by spending an additional $2 billion to complete the remaining portions of the program may not be realized. GAO recommends that the Administrator of the Environmental Protection Agency suggest that San Francisco reexamine certain aspects of the program and modify it to achieve water quality objectives in a more cost-effective manner. (Author's abstract)
W86-05807

PRODUCT-TESTS IN A MODEL WATER TREATMENT PLANT. BIODEGRADABILITY AND TOXICITY TESTS IN THE BASF TOXIMETER,

BASF A.G., Ludwigshafen am Rhein (Germany, F.R.).
U. Pagga.
Zeitschrift fuer Wasser-und Abwasser Forschung ZWABAQ, Vol. 18, No. 5, p 222-232, October 1985. 16 fig, 8 ref.

Descriptors: *Toxicity, *Activated sludge, *Wastewater treatment, Sludge, Toximeters, Shock loading, Respiration, Biodegradation, Organic carbon.

The toximeter can detect toxic substances in the influent to a biological water treatment plant if they directly inhibit respiration of the activated sludge. Shock loadings that are responsible for a roughly 50% suppression of respiration also effect a pronounced deterioration in quality at the Toximeter effluent. The Toximeter is also a suitable model for waste water treatment experiments. Various test substances, e.g., 3,5-dichlorophenol, diethyleneglycol, piperazine, are taken as examples to illustrate their influence on the respiration process and the DOC-elimination. The relationship between respiration and the concentration of the test substance is shown. The advantages are demonstrated of quantifying a pollutant effect in terms of the additional DOC load in the effluent and the pollution factor. Long-term toxicity and biodegradability tests can also be performed in the Toximeter. (Master-PTT)
W86-05826

THERMOPHILIC ANAEROBIC DIGESTION OF SUGARS IN UPFLOW ANAEROBIC SLUDGE BLANKET REACTORS,

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
W. M. Wiegant, and G. Lettinga.
Biotechnology and Bioengineering BIBIAU, Vol. 27, No. 11, p 1603-1607, November 1985. 3 fig, 1 tab, 23 ref.

Descriptors: *Upflow anaerobic sludge blanket reactors, *Thermophilic anaerobic digestion, *Wastewater treatment, *Anaerobic digestion, Sludge, Sugars, Methane bacteria, Manure.

Numerous designs have been developed for the high-rate anaerobic treatment of wastewater. The upflow anaerobic sludge blanket (UASB) process is the most widely used in western Europe. The main advantage of UASB is that no specific support material is required. However, a sludge with good setting properties is necessary for successful operation of the UASB process. High-rate thermophilic systems require a high biomass retention. Four inocula (cow manure, mesophilic granular sludge, digested sewage sludge, and a mixture of these materials) were used to identify what bacterial source would be appropriate for start up of a thermophilic digestion system. Any bacterial source exerting a reasonable mesophilic methanogenic activity would suffice. THe thermophilic anaerobic digestion of sugars was found to be possible using UASB reactors. The efficiency of treatment and concommitant methane generation rates were high. (Adams-PTT)
W86-05830

CONTINUOUS PROCESS FOR DYE REMOVAL FROM LIQUID EFFLUENTS USING CARBONISED WOOL WASTE,

Ecole Nationale Superieure de Chimie de Toulouse (France).
G. Malmary, F. Perineau, J. Molinier, and A. Gaset.
Journal of Chemical Technology and Biotechnology JCTBED, Vol. 35A, No. 8, p 431-437, November 1985. 2 fig, 1 tab, 20 ref.

Descriptors: *Wastewater treatment, *Wool, *Dye industry wastes, *Absorption, Wastes, Filtration, Incineration.

Industrial dyeworks are often conspicuous due to discoloration of rivers and streams into which they discharge their waste. Research is needed to determine the most favorable operating conditions for the removal of dyes from aqueous solutions. The absorption process studied uses wool-carbonizing waste, which shows a remarkable capacity for fixing surfactants, metallic cations, and dyes. This study used the vegetable part of the wool-carbonizing waste to absorb the dye, Maxilon Red. A cocurrent operating mode followed by continuous filtration of the final overflow seems to be the most efficient method of treating aqueous effluent by absorption of dyes into the wool-carbonizing waste. A maximum dye removal rate of 98% was possible. The dye-loaded waste is then be eliminated by incineration. (Adams-PTT)
W86-05834

ZOOFLAGELLATES IN AN ANAEROBIC WASTE STABILIZATION POND SYSTEM IN MEXICO,

Universidad Nacional Autonoma de Mexico, Mexico City.
F. Rivera, A. Lugo, J. Ponce, F. Lares, and R. Ortiz.
Water, Air, and Soil Pollution, Vol. 27, No. 1-2, p 199-214, January 1986, 5 fig, 5 tab, 23 ref.

Descriptors: *Zooplankton, *Bioindicators, *Waste management, *Waste dumps, *Stabilization ponds, Mexico, Ponds, Pollution, Zooflagellates.

A protozoological survey was performed on waste stabilization lagoons to isolate, identify, and determine the incidence of zooflagellates present in these waters. A correlation between the species found and the physicochemical parameters determined was also done. Fifteen samplings were analyzed from June 1981 to April 1982. Free-living zooflagellates included: Bodo edax Klebs; Bodo caudatus Dujardin; Trepomonas agilis Dujardin; Pleuromonas jaculans Perty (all of them polisaprobic indicators); Bodo saltans Ehrenberg (a mesosaprobic indicator); and Bodomorpha minima Hollande. A human commensal species Enteromonas hominis Da-Fonseca, was also isolated. The performance of the lagoons was predominantly anaerobic. The temperature seemed to be the most influential factor on the incidence of the zooflagellates isolated, especially in winter time. The use of zooflagellate species as indicators of organic matter pollution to evaluate the quality of pond waters gave satisfactory results, which were comparable to those obtained by determining physicochemical parameters and other biological observations. The presence of zooflagellates in the effluent of the lagoons is indicative of a low performance efficiency. (Masters-PTT)
W86-05843

MONITORING AERATED LAGOON PERFORMANCE,

Union Camp Corp., Princeton, NJ.
G. W. Eischen, and J. D. Keenan.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 8, p 876-881, August 1985. 9 fig, 2 tab, 17 ref.

Descriptors: *Aerated lagoons, *Industrial waste water, *Wastewater treatment, Flow regime, Continuous flow stirred tank reactor, Lagoons, Tracers, Effluents.

Large aerated lagoons are often used for treating industrial waste and a knowledge of their system mixing characteristics is necessary to ensure the removal of the toxic and inhibitory substances. This analysis was done to show how the flow pattern in an aerated lagoon influences the way in which results of a monitoring and sampling program are interpreted. A waste treatment system representative of an aerated lagoon used in industrial applications and having a residence time of 8-10 days was investigated. Seven cases chosen for evaluation differed only in terms of the assumed flow regime. The flow regime was found to determine the concentration profile of a tracer in the effluent following an input pulse. The waste treatment system can be described as one or more continuous flow stirred tank reactors. (Adams-PTT)
W86-05844

EFFECT OF SELECTED METALS AND WATER HARDNESS ON THE OXYGEN UPTAKE OF ACTIVATED SLUDGE,

Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
K. E. Hartz, A. T. Zane, and S. K. Bhagat.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 9, p 942-947, September 1985. 3 fig, 5 tab, 22 ref.

Descriptors: *Activated sludge process, *Wastewater treatment, *Metal toxicity, *Hardness, Zinc, Cobalt, Antimony, Biomass, Calcium.

Biological wastewater treatment systems are sensitive to toxic pollutants. Trace amounts of certain elements are necessary for growth and metabolism of microorganisms. However, certain concentrations can inhibit biological activity. This study was done to determine the inhibitory effects of moderate concentrations of Zn, Co, and Sb on the activated sludge process, to see if water hardness afforded some protection against metal toxicity, and to determine synergistic or antagonistic reactions between various combinations of these metal ions. Co was the most inhibitory. One mg/L Co significantly inhibited sludge respiration at all three biomass concentrations used in the study. 1 mg/L Sb inhibited the lower two biomass concentrations. Ten mg/L Zn had not significant effects. The effect of Ca and the metal ions decreased as sludge biomass concentration increased from 610 to 995 to 1525 mg/L. (Adams-PTT)
W86-05845

SELECTION AND VERIFICATION OF HYDRAULIC FLOW MODELS FOR LAGOONS,

American Inst. of Chemical Engineers, New York.
R. W. Sackellares, and W. A. Barkley.
American Institute of Chemical Engineers, Symposium Series, Vol. 81, No. 246, p 117-129, 1985. 15 fig, 1 tab, 18 ref.

Descriptors: *Lagoons, *Mathematical models, *Wastewater treatment facilities, Hydraulic models, Backmix ratio, Forest products industry, Axial dispersion model, Variance.

Hydraulic patterns in full-scale aerated stabilization basins (ASBs) were investigated. The results of these studies indicate that residence time distribution data from ASBs can be fitted to an axial dispersion model. However, a mechanistic lagoon treatment model benefits from hydraulic compartments-in-series model. Analysis of a continuously-stirred tank-reactor backmix model yielded satisfactory model-fitting results for several backmix ratio and m=number of reactor pair combinations. In order to determine the unique backmix flow ratio it was necessary to undertake mixing studies internal to the ASB. In internal ASB mixing studies, it appears that selection of reactor volume, concentrations, and flow patterns are of major importance in obtaining results with acceptable variance. Studies of internal flow regimes are continuing with emphasis on experimental data collection techniques and methods of data analysis. (Rochester-PTT)
W86-05846

USE OF MICELLAR-ENHANCED ULTRAFILTRAION TO REMOVE DISSOLVED ORGANICS FROM AQUEOUS STREAMS,

Oklahoma Univ., Norman. School of Chemical Engineering and Materials Science.
R. O. Dunn, J. F. Scamehorn, and S. D. Christian.
Separation Science and Technology SSTEDS, Vol. 20, No. 4, p 257-284, June 1985, 4 tab, 8 fig, 39 ref. DOE Contract DE-AS05-84ER13175.

Descriptors: *Ultrafiltration, *Water treatment, *Wastewater treatment, *Filtration, *Micellar-enhanced ultra-filtration, *Organic compounds, Solute rejection, Separation techniques.

Traditional ultrafiltration is ineffective at removing dissolved low molecular weight organics from water. In micellar-enchnced ultrafiltration (MEUF), surfactant is added to the water at concentrations well above the critical micelle concentration. Almost all of the organic orginally dissolved (the solute) solubilizes in the micelles formed by the surfactant. The solution then passes through an ultrafiltration membrane with pores small enough to block micelle passage. The permeate contains (at most) the unsolubilized solute and the surfactant monomer, both at very low concentrations. The criteria for selecting a surfactant are considered and MEUF is tested on an aqueous stream containing 4-tert-butyl-phenol with hexadecylpyridinium cloride as the surfactant. At high surfactant concentrations (0.25 M) in the retentate, rejections decrease, probably owing to the formation of n-mers (e.g., dimers, trimers,) which are able to pass through the pores along with some sulubilized solute. Also under these conditions, the viscosity increases while fluxes decline sharply. So long as these high surfactant concentrations are avoided, MEUF is an extremely effective separation technique, resulting in an average solute rejection of 99.7%, a permeate/feed retio of 87%, and good fluxes under the conditions studied. (Author's abstract)
W86-05848

BEHAVIOR OF ACTIVATED SLUDGE WITH DYES,

Gifu Univ. (Japan). Dept. of Chemistry.
E. Idaka, T. Ogawa, C. Yatome, and H. Horitsu.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 35, No. 6, p 729-734, December 1985, 3 fig, 1 tab, 11 ref.

Descriptors: *Activated sludge process, *Dyes, Sludge, *Color removal, *Wastewater treatment, Effluents, Biological oxygen demand, Dye industry wastes.

This study examines the effects of the dyes Congo Red, Orange II, and Crystal Violet on the growth of activated sludge. It also examined how quickly activated sludge removes these dyes from wastewater. In particular, dyes were placed in sludge and the rate at which color faded was studied. This procedure was repeated with various concentrations. It was found that at a dye concentration of 10002 mol/L at a biological oxygen demand (BOD) of 18,000 ppm (equivalent to 100 times that of municipal sewage), the color loss rate was highest but at a BOD of 3,200 ppm the cell growth is completely inhibited. (Jones-PTT)
W86-05852

ZERO DISCHARGE WATER TREATMENT DESIGN HAS HIGH RELIABILITY,

Burns and McDonnell, Kansas City, MO.
F. L. Shorney, W. P. Grobmyer, and G. Taylor.
Power Engineering, Vol. 89, No. 10, p 50-53, October 1985. 2 tab.

Descriptors: *Wastewater treatment, *Water treatment, *Industrial water, *Water reuse, *Zero discharge, Laramie River, Electric power production, Chemical properties, Silica, Alkalinity, Hardness, Turbidity, Lime.

Makeup water for all plant water systems and wastewater treatment at the Laramie River power station is provided by a treatment system specially designed to meet requirements based on the existing raw water sources. Over a two-year period, the 100% reliability of this system was a key factor in the ability of the plant to remain in operation continuously. Some water used for the Laramie River power station contains much silica, hardness, turbidity, and alkalinity. To obtain zero-discharge, the plant's balance flow diagram uses water conservation and reuse and recycle concepts. Treatment processes at the water plant include two-stage, lime-soda ash softening with carbonate hardness, turbidity, and silica removal in the primary basins using chemical additions of lime and polymer, noncarbonate hardness and additional turbidity and silica removel in secondary basins using chemical additions of soda ash, ferric chloride and polymer. Features of plant operation, including raw water quality, chemical costs, other economic considerations, the treatment basins, and sludge handling are also considered. (Jones-PTT)
W86-05863

HOW TO CALIBRATE A CHLORINE RESIDUAL ANALYZER,

Central Contra Costa County Sanitary District, Martinez, CA.
B. Dhaliwal, J. Snyder, and G. Williams.
Operations Forum, Vol. 3, No. 3, p 16-19, March 1986. 4 fig.

Descriptors: *Residual Chlorine, *Calibrations, Wastewater Treatment, Chlorine, Monitoring, Chlorination.

The Central Contra Costa Sanitary District controls and monitors its chlorination/dechlorination process using three separate chlorine residual analyzers. The first controls chlorine dosage, the second controls sulfur dioxide dosage, and the third monitors the dechlorinated effluent for chlorine. An improved procedure was developed for calibrating the analyzers. The new procedure consists of three steps: zero adjustment, calibration, and resumption of normal flow. The new method gives consistent results with no daily up and down adjustments of the equipment. Operators have had to adjust zero only a few times, and there has been no need to adjust the calibration span. (Doria-PTT)
W86-05874

KRAFT WASTEWATER CLEANING WITH POLYMERIC ADSORBENTS,

Universidad Complutense de Madrid (Spain). Dept. de Quimica Industrial.
A. Vian, E. Castro, and J. J. Rodriguez.
Separation Science and Technology SSTEDS, Vol. 20, No. 5 & 6, p 481-487, July-August 1985. 3 fig, 1 tab, 12 ref.

Descriptors: *Wastewater treatment, *Polymeric adsorbents, Activated carbon, Amerlite, Resins, Ion exchange, Polymer.

A procedure was developed for kraft wastewater cleaning that starts by dividing the total effluent into three main streams based on their composition. Wastewater resulting from the final steps of pulp washing and bleaching operations and accidental black liquor overflows from the recovery section, integrate into the lignocellulosic waste stream which is difficult to treat. It carries chemical species derived from lignin as well as cellulose and hemicelluloses hydrolysis, is brown in color, and has significant chemical oxygen demand and biochemical oxygen demand values. Lignocellulosic kraft wastewater cleaning by adsorption was studied using polymeric Amberlite XAD-7. The resin shows a suitable retention capacity for ligninic compounds but not for carbohydrates derived from cellulose and hemicelluloses. (Khumbatta-PTT)
W86-05875

SELECTING POLYMERIC FLOCCULANTS FOR WATER TREATMENT,

Calgon Corp., Pittsburgh, PA. Water Management Div.
For primary bibliographic entry see Field 5F.
W86-05876

STATION EMPLOYS GIANT SUBMERSIBLE PROPELLER PUMPS,

Spotts, Stevens and McCoy, Inc., Wyomissing, PA.
For primary bibliographic entry see Field 8C.
W86-05878

COMPUTERIZATION OF SEWER MAINTENANCE SCHEDULING PART 1 - PRINCIPLES OF OPERATION,

Schaaf and Wheeler, San Jose, CA.
For primary bibliographic entry see Field 7C.
W86-05879

ENGINEER'S VIEW OF PRIVATIZATION: THE CHANDLER EXPERIENCE,

Pirnie (Malcolm), Inc., White Plains, NY.
For primary bibliographic entry see Field 6E.
W86-05881

PRIVATE OPERATION OF U.S. WATER UTILITIES,

Operations Management International, Inc., Kingwood, TX.
For primary bibliographic entry see Field 6C.
W86-05883

INHIBITION KINETICS OF NITRIFICATION IN CONTINUOUS-FLOW REACTORS,

Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Rozich, and D. J. Castens.
Water Pollution Control Federation Journal JWPFA, Vol. 58, No. 3, p 220-226, March 1986. 8 fig, 5 tab, 22 ref. OWRT Grant No. 14-08-0001-G833/07.

Descriptors: *Nitrification, *Continuous flow, *Inhibition, *Kinetics, *Wastewater treatment, Ammonia, Municipal wastewater, Industrial wastewater, Mathematical equations, Activated sludge.

A two-stage continuous culture system was fed a synthetic ammonia waste devoid of organic carbon, to assess the nature, inhibitory or non-inhibitory, of ammonia-limited nitrification. The results of these studies indicated that nitrifier growth kinetics are best represented with a substrate inhibition function such as the Haldane equation. Data from these studies suggested that nitrifier growth followed an inhibitory pattern, which means that the use of the Monod equation for representing nitrification is mechanistically inappropriate. The fact that nitrifier growth kinetics

are inhibitory, militates that present activated sludge nitrification technology should be open for modification. The behavior of a continuous-flow reactor that treats inhibitory compounds is radically different from the same reactor that treats wastes which adhere to Monod kinetics. The substrate inhibition nature of nitrifier kinetics provides some explanation of the instabilities often encountered with nitrification performance in treatment plant facilities. Consequently, it is desirable to implement operating strategies that will provide the greatest degree of stability to substrate removal kinetics in the aeration basin. Implementation of these strategies should result in more consistent performance with regard to ammonia removal for nitrifying activated sludge systems. (Doria-PTT)
W86-05894

ANAEROBIC TREATMENT OF PHENOL BY AN EXPANDED-BED REACTOR,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
Y. T. Wang, M. T. Suidan, and B. E. Rittman.
Water Pollution Control Federation Journal JWPFA, Vol. 58, No. 3, p 227-233, March 1986. 8 fig, 3 tab, 21 ref. EPA Contract No. EPA R-809750-01.

Descriptors: *Phenol, *Expanded-bed reactor, *Anaerobic digestion, Wastewater treatment, Effluents, Industrial wastes, Methane, Chemical oxygen demand, Biological oxygen demand, Activated carbon.

The organic removal efficiency of an expanded-bed anaerobic reactor, using granular activated carbon as a biological attachment medium, was very high when subjected to a wide range of feed phenol concentrations during 588 days of continuous operation. Steady-state phenol, chemical oxygen demand (COD), and dissolved oxygen carbon (DOC) removal efficiencies exceeded 99.9, 92, and 93%, respectively, even for the highest loading conditions. By the end of this study, 87.5% of the feed COD was converted to methane gas. Only 6% of the feed COD escaped in the aqueous effluent from the anaerobic reactor. The high conversion to methane and the low retention of COD within the reactor demonstrate that biological utilization was the major removal mechanism and the net growth of bacteria in the reactor was low. The major conclusion of this study was that the granular activated carbon expanded-bed reactor achieved nearly 100% removal of phenol when the surface loading ranged from 0.028 to 0.23 mg/sq cm x d COD. (Doria-PTT)
W86-05895

ADSORPTION OF LEAD AND ZINC ON BLAST FURNACE IRON OXIDE SOLIDS,

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
J. R. Mihelcic, and R. G. Luthy.
Water Pollution Control Federation JWPFA, Vol. 58, No. 3, p 242-249, March 1986. 12 fig, 1 tab, 33 ref. EPA Grant No. R809628.

Descriptors: *Lead, *Water reuse, *Wastewater treatment, *Zinc, *Iron oxide, Recirculated water, Effluents, Steel industry, Sorption, Model studies, Hydrogen ion concentration, Adsorption, Chemical precipitation, Organophosphorus compounds.

The adsorption of lead and zinc was evaluated on blast furnace recycle scrubber water system solids consisting of iron oxides. The metals displayed characteristic pH-adsorption edges which were displaced to more alkaline pH values at lower solids concentration. The desorption-adsorption of relatively high concentrations of lead and zinc at high solids concentration can be described by a model in which the metal-solid interaction was interpreted as a surface complex. The removal of relatively high concentrations of zinc in the presence of relatively low solids concentration depended more on chemical precipitation than surface adsorption, while the removal of relatively high concentrations of zinc in the presence of moderately high solids concentration seemed to depend in part on adsorption and in part on lowered solubility product for Zn(OH)2(s) at the solid solution interface. Metal adsorption tests in the presence of an organophosphonate antiscalant compound demonstrated that the compound exhibited a competing reaction for the removal of either lead or zinc from solution by surface adsorption/chemical precipitation. Improvement in modeling the adsorption of metal in the presence of an organophosphonate antiscalant requires specific information on adsorption characteristics of the metal-HEDP complex. (Doria-PTT)
W86-05897

BLAST FURNACE RECYCLE WATER QUALITY AND REACTIONS OF LEAD AND ZINC,

Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering.
R. G. Luthy, E. R. Sable, and F. C. McMichael.
Water Pollution Control Federation Journal JWPFA, Vol. 58, No. 3, p 250-260, March 1986. 9 fig, 6 tab, 46 ref. EPA Grant No. R809628.

Descriptors: *Recirculated water, *Water reuse, *Wastewater treatment, *Blast furnaces, *Lead, *Zinc, Effluents, Heavy metals, Steel industry, Model studies, Carbon dioxide, Chemical reactions, Organophosphorus compounds.

Chemical components of blast furnace gas (BFG) recycle scrubber water systems can be modeled as a complete-mix system. CO2 chemistry in the recycle water fluctuates between that for a closed system in the scrubber and that for an open system in the cooling tower. Two chemical equilibrium modeling approaches indicated that the recycle water was supersaturated with CaCO3(s), justifying the need for an organic phosphonate antiscalant chemical treatment program. Solids in the BFG recycle scrubber water were comprised of iron oxides, and lead and zinc were desorbed from the solid surface to approximately 50 and 230 mg/l, respectively, at 50 g/l solids. Metal desorption-adsorption studies with lead and zinc and solids at these same concentrations showed characteristic pH-adsorption edges for these metals. Additional chemical modeling evaluations demonstrated that when adsorption was occurring, metal removal was not the result of chemical precipitation in either laboratory tests or in simulated field conditions. These results showed that chemical modeling approaches can be used to describe some important chemical properties of these systems, which can lead to better operation for recycle and application of water treatment chemicals and to improved control of regulated constituents such as lead and zinc. (Doria-PTT)
W86-05898

LIQUID-PHASE MASS TRANSFER COEFFICIENTS FOR SURFACE IMPOUNDMENTS,

Arkansas Univ., Fayetteville.
P. D. Lunney, C. Springer, and L. J. Thibodeaux.
Environmental Progress ENVPDI, Vol. 4, No. 3, p 203-211, August 1985. 5 fig, 12 tab, 30 ref. EPA Agreement No. CR-808161-02.

Descriptors: *Mass transfer, *Hazardous wastes, *Surface impoundments, *Fate of pollutants, Wind velocity, Volatility, Air-water interfaces, Model studies, Volatile organics, Mathematical analysis, Water depth, Simulation analysis.

Accurate predictions of the volatile organic carbon (VOC) emission rate from surface impoundments are necessary to develop regulations and assess the threat to the public. The individual liquid phase coefficient for the natural zone is probably the single most important parameter for predicting VOC emissions. A predictive correlation was produced from measured laboratory coefficients, and compared to established correlations and field estimates. It is concluded that, in addition to the previously documented enhancement of the liquid-phase mass transfer coefficient due to wind velocity, there is also an enhancement due to depth of the water system. The coefficient can be described as a function of the square of wind velocity, and generally approaches a maximum value with decreasing depth for a system of constant fetch. The depth enhancement of the coefficient can be described in terms of the dimensionless fetch to depth ratio, which apparently renders laboratory simulators comparable to each other and to the environment. The general correlation presented here is probably the only relationship which can explain the apparent discrepancy between field observations and laboratory data. (Doria-PTT)
W86-05900

REMOVAL OF TRACE LEVELS OF DIOXINS FROM WATER BY SORPTION ON MODIFIED CLAY,

Michigan Univ., Ann Arbor. Dept. of Chemical Engineering.
K. R. Srinivasan, H. S. Fogler, E. Gulari, T. Nolan, and J. S. Schultz.
Environmental Progress ENVPDI, Vol. 4, No. 4, p 239-245, November 1985. 4 fig, 4 tab, 20 ref.

Descriptors: *Wastewater treatment, *Dioxins, *Sorption, *Clay, Chemical treatment, Humic acid, Partitioning, Montmorillonite, Infrared spectroscopy, Ion exchange, Copper, Iron.

Removal of trace organic pollutants such as polychlorinated biphenyls and polychlorinated dioxins from industrial effluent water may be accomplished by adsorption on a suitable sorbent which may subsequently be disposed of with relative ease. Consequently, efforts are being made to develop a cost-effective, synthetic sorbent based on modified montmorillonite. Chemical treatment and infrared spectroscopy measurements on the modified clay have been undertaken to probe the nature of the sorbent. It was found that complexes between the clay and humic acid can be made irreversible through a sandwich layer of positive charge provided by hydroxy-aluminum, with partition coefficients as high as 40,000. Humic acid binds reversibly and in large amounts to Cu(2+) and Fe(3+) clay, although more than 80% of bound humic acid desorbs upon washing with de-ionized water. The irreversible binding of humic acid to modified clay is due to nonexchangeability of hydroxy-aluminum, chelate formation between bidentate HA and modified clay, and ion exchange binding. (Doria-PTT)
W86-05901

EFFECT OF OZONATION AND UV IRRADIATION ON BIOREFRACTORY ORGANIC SOLUTES IN OIL SHALE RETORT WATER,

California Univ., Richmond. Sanitary Engineering and Environmental Health Research Lab.
B. M. Jones, G. W. Langlois, R. H. Sakaji, and C. G. Daughton.
Environmental Progress ENVPDI, Vol. 4, No. 4, p 252-258, November 1985. 7 fig, 42 ref. DOE Contract No. DE-AC03-76SF00098.

Descriptors: *Wastewater treatment, *Ozonation, *Ultraviolet radiation, *Organic compounds, Oil shale, Retort water, Oxidation, Biodegradation, Refractivity, Mineralization, Organic carbon.

Organic solutes in oil-shale retort waters are extremely refractory to both chemical and microbial oxidation. Ozonation, UV irradiation, and combined UV/ozonation were evaluated both for their ability to directly oxidize organic solutes and for their indirect influence on biodegradability (through minor structural alterations) of refractory compounds in Oxy-6 retort water. UV irradiation of retort water appeared to be ineffective because of the presence of photooxidation inhibitors. Extensive ozonation altered a significant portion of the biorefractory organic solutes, most likely as a result of direct oxidation by the parent ozone molecule. Extensive UV irradiation combined with ozonation effected mineralization of a substantial portion of the DOC after six hours, but further biological treatment was unsuccessful. Although color and odor were nearly eliminated, 41% of the dissolved organic carbon remained after exhaustive serial treatment by primary biooxidation, UV/ozonation, and secondary biooxidation. The organic solutes that remained appeared to be refractory to both chemical and microbial oxidative alteration or mineralization. (Doria-PTT)
W86-05902

DRINKING WASTEWATER,

For primary bibliographic entry see Field 3C.
W86-05929

PERFORMANCE EVALUATION OF THE ANAEROBIC FLUIDISED BED SYSTEM: I. SUBSTRATE UTILISATION AND GAS PRODUCTION,

National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
S. J. Chen, C. T. Li, and W. K. Shieh.
Journal of Chemical Technology and Biotechnology, Vol. 35B, No. 2, p 101-109, June 1985. 8 fig, 2 tab, 11 ref.

Descriptors: *Performance evaluation, *Anaerobic digestion, *Fluidized bed process, *Substrates, *Gas production, *Wastewater treatment, Fluidized beds, Biodegradation, Biological treatment, Digestion, Chemical oxygen demand, Methane, Hydrogen ion concentration, Alkalinity.

Removal efficiencies for chemical oxygen demand (COD) in the range 75 to 98% were achieved in an anaerobic fluidized bed system designed for the recovery of methane from liquid wastes, when evaluated at COD loadings of between 5.8 to 108 kg per cu m per day, hydraulic retention times of between 4.45 to 8 h, and feed COD concentrations of between 480 to 9000 per cu dm. More than 90% of feed COD could be removed up to COD loadings of about 40 kg per cu m per day. Up to around 300 sq dm of methane were produced per kg COD removed, and this methane production rate was independent of the COD loadings applied in this investigation. Volatile acid concentration in the reactor increased sharply at a COD loading of about 40 kg per cu m per day, suggesting that sufficient alkalinity be provided to prevent pH from dropping to the undesirable level. The anaerobic fluidized bed system can be operated at significantly higher liquid throughputs while maintaining its excellent efficiency. (Doria-PTT)
W86-05940

ANAEROBIC TREATMENT OF PALM OIL MILL EFFLUENT BY TANK DIGESTERS,

Malaya Univ., Kuala Lumpur (Malaysia). Dept. of Chemistry.
C. C. Ho, and Y. K. Tan.
Journal of Chemical Technology and Biotechnology, Vol. 35B, No. 2, p 155-164, June 1985. 6 fig, 4 tab, 17 ref.

Descriptors: *Anaerobic digestion, *Palm oil mill effluent, *Food-processing wastes, *Tank digester, *Wastewater treatment, Effluents, Biodegradation, Lime, Digestion, Biological treatment.

Palm oil mill effluent was treated anaerobically in 210 per cu dm tank digesters in which inoculation with anaerobic seeding coupled with careful addition of lime could shorten the natural stabilization process to about 30 days. The system was subsequently scaled up to 500 tons capacity. The characteristics of the anaerobically digested liquors were studied at 10 and 20 days hydraulic retention time (HRT), respectively, and close to 90% treatment efficiency could be achieved at 20 days HRT with complete microbial conversion of plant cell debris. However, the digested liquor still contained 0.325% (by wt) suspended solids. The kinetics of the anaerobic process show close resemblance to those treating other high strength organic wastes. Optimum gas production occurred only over a narrow pH range of 6.8-7.2 units. A methane content of 62-67% on gas production was noted about equivalent to 0.34 to 0.39 per cu dm CH4 per g of biological oxygen demand (BOD) destroyed. (Doria-PTT)
W86-05941

PERFORMANCE EVALUATION OF THE ANAEROBIC FLUIDISED BED SYSTEM: II. BIOMASS HOLDUP AND CHARACTERISTICS,

National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
S. J. Chen, C. T. Li, and W. K. Shieh.
J. Chemical Technology and Biotechnology, Vol. 35B, No. 3, p 183-190, September 1985. 6 fig, 1 tab, 12 ref.

Descriptors: *Liquid wastes, *Anaerobic digestion, *Fluidized bed process, *Biomass, *Wastewater treatment, Performance evaluation, Methane recovery, Fluidized bed, Biodegradation, Biological treatment, Methane, Digestion, Waste recovery, Chemical oxygen demand, Biofilm, Sludge.

The biomass holdup and characteristics of the anaerobic fluidized bed system for methane recovery from liquid wastes was examined at chemical oxygen demand (COD) loadings of 5.8 to 108 kg per cu m per day, hydraulic retention times of 0.45 to 8 h, and feed COD concentrations of 480 to 9000 mg per cu dm. Under these operating conditions, the equilibrium biomass holdups increased with increasing COD loadings and varied from 15000 to 32000 mg VSS per cu dm. The distribution of biomass holdup and biofilm thickness in the reactor was relatively uniform, because of the completely mixed conditions maintained and the continuous sloughing of biofilms induced by the effervescence caused by rising methane bubbles. This continuous biofilm sloughing process also eliminated the need for intentional sludge wasting and consequently, the resulting sludge retention time in the reactor decreased with increased COD loadings. Results clearly demonstrate the ability of the anaerobic fluidized bed system to retain a high biomass holdup. As a result, this system is ideal for high-rate methane recovery from liquid wastes, even at low feed COD concentrations. (Doria-PTT)
W86-05942

EFFECT OF PRETREATMENT ON THE ENZYMIC HYDROLYSIS OF CELLULOSIC INDUSTRIAL WASTE,

Ecole Polytechnique, Montreal (Quebec). Dept. of Chemical Engineering.
P. Toussaint, and P. F. Bataille.
Journal of Chemical Technology and Biotechnology, Vol. 35B, No. 3, p 205-215, September 1985. 9 fig, 4 tab, 38 ref.

Descriptors: *Pretreatment, *Hydrolysis, *Enzymes, *Industrial wastes, *Cellulosic waste, *Wastewater treatment, Pulp wastes, Biodegradation, Enzyme.

The enzymic hydrolysis of cellulosic waste material from industrial origins using commercial Trichoderma viride cellulase gave yields approaching 80% conversion following pretreatments. The yield was a function of the purity of the substrate as well as the pretreatments imposed. These included sterilization, heating, ball-milling, and alkali treatment. Highest yields of glucose or enzyme hydrolysis were achieved with a 4% solka floc suspension following pretreatment in 5% alkali, when the enzyme mix was 0.22IU per cu cm of filter paper activity, 0.07IU per cu cm C sub x enzyme activity, and 0.14IU per cu cm of beta-glucosidase activity. Kraft pulp also gave up to 75% yields by this method. (Author's abstract)
W86-05943

SUMMIT SPURS ACID RAIN ACTION,

For primary bibliographic entry see Field 5B.
W86-05950

IMPROVEMENT IN THE EFFECTIVENESS OF OZONATION OF DRINKING WATER THROUGH THE USE OF HYDROGEN PEROXIDE,

Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
J. P. Duguet, E. Brodard, B. Dussert, and J. Mallevialle.
Ozone Science and Engineering OZSEDS, Vol. 7, No. 3, p 241-258, Summer 1985, 13 fig, 3 tab, 16 ref.

Descriptors: *Drinking water, *Water treatment, *Ozonation, *Hydrogen peroxide, Organic carbon, Trihalomethane.

Addition of hydrogen peroxide to water during ozonation increases the rate of oxidation of organic compounds and ozone transfer. Coupling ozone with hydrogen peroxide can increase the efficiency of a drinking water treatment line, for example in removing trihalomethane precursors. To optimize this oxidation process, the quantity of hydrogen peroxide added and the point of injection must be carefully selected. (Authors' abstract)
W86-05989

EFFECT OF BROMIDE ION IN WATER TREATMENT: II. A LITERATURE REVIEW OF OZONE AND BROMIDE ION INTERACTIONS AND THE FORMATION OF ORGANIC BROMINE COMPOUNDS,

Florida International Univ., Miami. Drinking Water Quality Research Center.
W. J. Cooper, R. G. Zika, and M. S. Steinhauer.
Ozone Science and Engineering OZSEDS, Vol. 7, No. 4, p 313-325, Fall 1985, 1 fig, 48 ref. EPA Cooperative Agreement CR-810277-01.

Descriptors: *Ozonation, *Bromides, Water treatment, *Drinking water, *Organic bromine, Bromate Ion, Hypobromite Ion, Trihalomethanes, Chlorination, Hydrogen ion concentration.

Where bromide ion occurs in a drinking water source and chlorination is used for disinfection, bromide ion is oxidized to bromine and can result in the formation of organic bromine compounds. There are no treatment techniques available for the economic removal of bromide ion. A potential treatment is to use an alternative oxidant such as ozone. A review of the reactions of ozone and bromide ion indicates possible treatment strategies to minimize the formation of trihalomethanes where ozone is used in the presence of bromide ion, e.g., use of an ozone concentration >15 m/L or adjustment of the pH to relatively higher values. Future research should focus on the effect of various concentrations of natural aquatic humics on the formation of CHBr3 in ozonated water containing Br(-) and on identifying reaction products of model organics ozonated in aqueous solutions containing Br(-) to determine the extent of free radical formation. (McFarlane-PTT)
W86-05990

IMPROVE COLD-WEATHER WASTEWATER TREATMENT,

Amoco Corp., Chicago, IL.
J.F. Grutsch.
Hydrocarbon Processing, Vol. 64, No. 10, p 47-50, October 1985, 5 fig, 2 tab. 7 ref.

Descriptors: *Wastewater treatment, *Cold regions, *Industrial wastewater, *Biological wastewater treatment, *Activated sludge process, Flocculation, Sludge Seeding, Wastewater treatment, Coagulation.

One important step for improving cold-weather wastewater treatment is keeping inert materials from the system. This is done by optimizing the pretreatment dissolved air flotation (DAF) unit. The key to optimizing the DAF is proper coagulation/flocculation with a very-high-molecular-weight polyelectrolyte such as a MAPTAC (3-methacryloxy-2-hydroxypropyltrimethylammoniium chloride) or METAC (2-methacryloxyethyltrimethylammonium chloride) acrylamide copolymer. The flocculation of the activated sludge for rapid and complete settling in the clarifier is another important capability to optimize. Minimizing inerts to the unit helps. Careful pumping of return sludge is important to minimize pressure drops, velocity, etc. that triturate particles and require their reflocculation. On an emergency basis, the addition of a DMA/EPI (dimethylamine-epichlorohyrdrin) polyelectrolyte with a molecular weight of about 250,00 to the inlet of the clarifier can substantially improve the self-flocculating properties of activated sludge. (David-PTT)
W86-06005

PILOT-SCALE REUSE SYSTEM FOR SALMONIDS,

Fish and Wildlife Service, Cortland, NY.

S. G. Hughes, and R. C. Williams.
Progressive Fish Culturist, Vol. 47, No. 4, p 251-253, October 1985. 1 fig, 1 tab, 4 ref.

Descriptors: *Tertiary treatment, *Ozone, *Atlantic salmon, *Rainbow trout, *Water reuse, *Fish hatcheries, Temperature, Growth, Fish physiology, Lake trout, Brook trout, Tunison water reuse system, Pilot plants, Mortality.

An enlarged modification of the 'Tunison' system for water reuse in fish hatcheries is described; this design uses ozone for tertiary water treatment. The enlarged reuse system has a total water capacity of 6,057 liter and supports 33 6.5-liter hatchery jars along with five troughs of 3.05 m in length and containing 397 liter of rearing volume. Growth of Atlantic salmon (Salmo salar) and rainbow trout (S gairdneri) has been excellent. The warm water temperatures in the reuse system (16-22 C), maintained by the ambient air temperature, have led to five-fold increases in growth of these species during certain periods compared to fish raised under normal hatchery conditions. Lake trout (Salvelinus fontinalis) and brook trout (Salvelinus namaycush) have also been reared in the reuse system, but when the temperatures exceeded 19 C they became obviously stressed and mortality increased significantly compared to normal levels. (Rochester-PTT)
W86-06007

DOMESTIC WASTEWATER TREATMENT BY PEATLANDS IN A NORTHERN CLIMATE: A WATER QUALITY STUDY,

Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
Y. Dubuc, P. Janneteau, R. Labonte, C. Roy, and F. Briere.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 297-303, April 1986. 2 fig, 4 tab, 10 ref.

Descriptors: *Peat soils, *Wastewater treatment, *Cold regions, Canada, Tertiary treatment, Wastewater treatment facilities, Aeration, Biochemical oxygen demand, Chemical oxygen demand, Hardness, Inorganic carbon, Orthophosphate, Phosphorus, Ammonia, Nitrogen, Biological Treatment, Adsorption.

The use of peatlands as the main form of wastewater treatment in a northern climate was studied for the James Bay Energy Society at the Fontanges campsite, Canada, (70 deg, 17 min, 30 sec W, 54 deg 34 min 00 sec N). In less than 1.5 km from the point of discharge, BOD5, COD, total hardness, inorganic carbon, orthophosphates, total phosphorus, ammonia, and total nitrogen were reduced by at least 90%. The peatland treatment system studied was divided into four components, each having a specific function. The first part combines the action of microorganisms and adsorption on peat, thus reducing the organic content while increasing the inorganic constituents. The second part uses peat to absorb the inorganic elements already present in the wastewater and those produced in the first part of the system. The third part acts as an aerator, increasing the dissolved oxygen and decreasing the BOD5 levels of the water. The fourth part removes most of the remaining nutrients, thus acting like a tertiary treatment. Overall, peatlands seemed to be effective in treating domestic settled wastewater in a cold climate. (Author's abstract)
W86-06025

RECLAIMED CALIFORNIA WASTEWATER PROVIDES DROUGHT INSURANCE,

Moulton Niguel Water District, Laguna Niguel, CA.
For primary bibliographic entry see Field 3C.
W86-06040

AUTOMATING STORMWATER AND COMBINED SEWER SYSTEMS: THE POSSIBILITIES,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
N. S. Grigg, and W. Schilling.
Water/Engineering and Management WENMD2, Vol. 133, No. 5, p 33-35, May 1986. 2 ref.

Descriptors: *Storm wastewater, *Control systems, *Combined sewers *Automation, United States, Canada, Computers, Management, Political constraints, Metropolitan water intelligence system.

Automation of stormwater and combined sewer systems is reviewed and the conditions necessary for the success of automation are discussed, based on the past 15 yr experience and a recent inspection tour of facilities in the United States and Canada. There are a few combined sewer systems with some real time operation, but their scope of operation relies heavily on human supervision, and even the managers of successful systems are cautious about expansion into systemwide automatic control and giving away the control task to a computer. Good management and healthy organizations seem to be able to produce innovations such as automation, even in the absence of strong regulator constraints, whereas less competent management might be able to run a conventional system, but not a 'metropolitan water intelligence system.' Much action in developing control or automation of stormwater and combined sewer systems in the near future seems unlikely in view of the present political climate. (Rochester-PTT)
W86-06041

GRAVITY BELTS THICKEN SLUDGE ECONOMICALLY,

Envirex, Inc., Waukesha, WI.
R. A. Kormanik, and K. A. Dejewski.
Water/Engineering and Management WENMD2, Vol. 133, No. 5, p 37, 39, May 1986.

Descriptors: *Sludge conditioning, *Cost analysis, *Gravity belts, Design, Performance, Polymer conditioning, Field tests, Wastewater treatment, Facilities.

Design, operation, and performance are described for an alternative process for thickening raw and digested sludges, which can be tailored to plant designs and budgets. The thickener consists of two rolls mounted on a frame. A belt, similar to the type used on a belt press, moves over these rolls, driven by a variable speed drive unit. Polymer-conditioned sludge is fed into the unit and water drains through the belt as the sludge is ridged and furrowed to encourage drainage of released water. The unit was tested at 13 sites with 20 different sludges, with from 1 week to 5 months of data collection at each site. These test results suggest that the gravity belt offers an alternative thickening method that should be considered and weighed on its economic merits. The economics appear to be more favorable as the treatment plant size decreases or when an existing plant is being retrofitted, because the gravity belt unit occupies little space. (Rochester-PTT)
W86-06042

EFFECTS OF HEAVY METALS UPON THE BIOLOGICAL WASTEWATER TREATMENT PROCESS,

M. H. Gerardi.
Public Works PUWOAH, Vol. 117, No. 6, p 77-80, June 1986. 4 fig, 5 tab, 11 ref.

Descriptors: *Biological wastewater treatment, *Heavy metals, *Toxicity, *Process control, Publicly owned treatment works, Sludge solids, Land application, Stream pollutants, Flocculation, Nitrification, Anaerobic digestion efficiency, Chelating agents, Sulfide, Lime.

Influent concentrations of heavy metals (Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, and Zn) to publicly-owned treatment works (POTWs) typically are not high enough to affect the efficiency of biological treatment processes. Problems that can occur, if sufficient heavy metal concentrations are reached, include: development of hazardous concentrations in sludge solids, which prevents the disposal of solids by land application; degradation of effluent quality, i.e., decreased BOD, COD, and suspended solids removal efficiencies; deterioration or failure of the anaerobic digestion processes; the discharge of relatively high concentrations of heavy metals in the effluent, resulting in adverse effects on the receiving stream; the inhibition of proper biomass flocculation in the secondary sedimentation tanks; and the inhibition of nitrification within the activated sludge process. Partitioning of heavy metals during treatment, toxicity of heavy metals, operational problems, and control measures are discussed. Deflocculation, inhibition of nitrification, decreased anaerobic digestion efficiency, and accumulation of heavy metals within the sludge solids are of particular concern to the efficient operation and management of POTWs. Heavy metal control measures include increasing mixed liquor suspended solids, mean cell residence time, and/or organic loading; adding synthetic chelating agents to the wastewater; adding sulfide; or adding lime. (Rochester-PTT)
W86-06046

STUDY OF NITROGEN REDUCTION,

Dallas City Water Utilities Dept., TX.
C. L. Bridges.
Southwest and Texas Water Works Journal STWJDC, Vol. 68, No. 2, p 8, 10. May 1986.

Descriptors: *Pilot plants, *Nitrogen removal, *Activated sludge, *Aerators, Clarifiers, Mixed liquor solids, Dissolved oxygen, Design, Denitrification, Nitrification, Wastewater facilities, Settled sewage, Detention time, Scum.

Construction and operation of a small pilot plant for nitrogen removal is described. The pilot plant was built largely from materials and equipment on hand or borrowed and included a 54-gallon drum aerator, another 54-gallon drum as a clarifier, and a sludge return mechanism Tests were conducted with settled sewage such as might be applied to a large plant in the future. Sixty-three different configurations and parameters were tested. Tests showed that: (1) a depth of 34 inch in the aerator was inadequate (calculations indicated that an aerated depth of 12-16 feet would greatly enhance performance); (2) air consumption of 3.0 cu ft/gal of mixed liquor was the optimum rate; (3) aerator detention times of less than 3 hr gave poor results; (4) mixed liquor solids of 1,400-1,700 ppm were the best concentrations; (5) dissolved oxygen of 1.8-2.5 ppm in the aerator gave good results and produced little floating scum in the clarifier, and also permitted denitrification in the gravel bed; and (6) better than 95% nitrogen reduction was seen several times, confirming that nitrification can be induced in an activated sludge plant under appropriate conditions. (Rochester-PTT)
W86-06057

ZERO DISCHARGE STEAM ELECTRIC POWER GENERATING STATION,

Stearns Catalytic Corp., Denver, CO.
H. J. Martin, and G. R. Miller.
American Water Works Association Journal JAWWA5, Vol. 78, No. 5, p 52-58, May 1986. 7 fig, 4 tab, 3 ref.

Descriptors: *Zero discharge, *Electric powerplants, *Water reuse, Wastewater management, Brush Colorado, Engineering design, Potable water, Reverse osmosis.

The coal-fired Pawnee Steam Electric Generating Station located in the South Platte River Valley in Colorado has achieved a true zero discharge with no liquid wastes discharged beyond the station boundaries except for rainfall runoff from unimproved land. The wastewater management system is based on the concept of cascading to services requiring progressively inferior water quality. A small amount of reuse water is uded for fly ash conditioning and dust suppression but the major reuse mechanism is vapor compression evaporation. The primary water user and waste producer is the circulating water system and associated cooling towers. The water passes through wastewater concentrators before going to the boiler makeup treatment system. A reverse osmosis demineralizer provides dissolved solids reduction prior to final polishing during periods when the concentrators are not available or are operating at reduced ca-

pacity. The original design was based on systems that had been used successfully at similar plants but flexibility to permit modification of subsystems as required by changing circumstances without disrupting operation. The original plan incorporated the provision of potable water from treated wastewater but it proved unpalatable and left unsightly deposits; potable water is now pumped in from the municipal water supply. (Peters-PTT)
W86-06058

POSTTREATMENT OF REVERSE OSMOSIS PRODUCT WATERS,

Du Pont de Nemours (E.I.) and Co., Wilmington, DE.
L. E. Applegate.
American Water Works Association Journal JAWWA5, Vol. 78, No. 5, p 59-65, May 1986. 4 fig, 8 tab, 24 ref.

Descriptors: *Reverse osmosis, *Desalination, *Water treatment, Industrial water treatment, Demineralization, Ion exchange, Disinfection, Ultraviolet radiation, Degasification, Chlorine, Operating costs, Capital costs.

Reverse osmosis (RO) product water usually requires posttreatment, regardless of the type of RO device, the chemical nature of the RO membrane, and the intended application of the water. Posttreatment requirements depend primarily on the application and must be determined on a case-by-case basis. For many industrial applications, posttreatment consists of demineralization by means of ion exchange and disinfection with ultraviolet radiation. Posttreatments for municipal applications include pH adjustment with bases or a degasifier (or both), reduction of corrosiveness, and disinfection with chlorine. Details of these posttreatments are given for RO product waters from brackish as well as seawater sources. The economics of these treatment processes are also presented. (Author's abstract)
W86-06059

DETERMINATION OF TRACE POLYMER IN WASTE WATER,

Neya River Basin - Wide Sewage Works Association, Osaka (Japan).
T. Hanasaki, H. Ohnishi, A. Nikaidoh, S. Tanada, and K. Kawasaki.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 35, No. 4, p 476-481, October 1985. 8 fig, 1 tab, 5 ref.

Descriptors: *Trace polymers, *Wastewater treatment, *Flocculation, *Sewage treatment, Spectrophotometry, Temperature effects, Hydrogen ion concentration, Sewage sludge, Organic compounds.

Polymeric flocculation plays an important role in sludge dehydration in sewage treatment plants. Dehydration by polymeric flocculants for prevention of environmental pollution and energy conservation was investigated. An accurate method of determination is required for the measurement of a trace polymeric flocculant. Known quantities of flocculants were dissolved in distilled water, and a certain amount of each was put into a 50-ml volumetric flask to which 20 ml of an inorganic salt solution and successive 5-ml aliquots of tannic acid solution were added. The solutions were stirred for 1 min., and the sample was left to stand for 1 hr. The transmittance was measured with a spectrophotometer. All calibration curves showed linearity and nonionic flocculant could be determined even at low concentration because of the sensitivity of the calibration curve. Temperature, pH, and salt concentration were investigated. Transmittance was independent of temperature in the range of 10 C to 30 C and was high under acidic conditions. It is therefore preferable that determinations be made at pH values <7. An investigation was conducted as to how organic matter in real waste water sludge affects the determination and how to remove it. Ethylenediamine tetrasodium acetate (EDTA) was added to a prepared sample of polymeric flocculant solution to prevent interference. For determining low concentrations of cationic and nonionic flocculants and screening real waste water using the supernatant liquid from sludge, it was found that the addition of EDTA could be applied for determination of the flocculant contained in the waste water. (Main-PTT)
W86-06068

CONTAMINATION AND GROWTH OF THE SHRIMP, PENAEUS STYLIROSTRIS STIMPSON, CULTURED IN A SEAWATER/WASTEWATER AQUACULTURE SYSTEM,

Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
For primary bibliographic entry see Field 3C.
W86-06071

NEUTRALIZATION OF WASTEWATERS CONTAINING CYANIDES, PART 1: FORMATION OF INSOLUBLE COMPOUNDS,

Marie Curie-Sklodowska Univ., Lublin (Poland). Dept. of Environmental Chemistry and Technology.
R. Gierzatowicsz, L. Pawlowski, and E. Smulkowska.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 12, p 426-427, December 1985. 1 tab.

Descriptors: *Wastewater treatment, *Cyanide, Chemical precipitation, Neutralization, Industrial wastes, Utilities, Coal, Sludge, Cost analysis, Anion exchange, Resins.

Cyanogenic substances introduced as processing refuse into the environment (dust, gases, liquid as well as solid wastes) are a danger to the biosphere. The most significant manufactures of cyanogenic refuses are the steel, photochemical, raw material, and pharmaceutical industries. Choice of the specific process of detoxification depends on practical requirements. In choosing the cleaning process, the following rules should be considered: the reaction of cyanide destruction must run quickly and irreversibly; prime costs should be minimal; and detoxification installations, storage and reagent feeding systems, control and automatic system should be as simple as possible. In precipitation, cyanides are removed as sparingly soluble complexes of heavy metals which are stored as sludge on protected dumping grounds. Another method of precipitation is waste-plus-waste, where wastes are mixed, self-neutralization occurs, and well-sedimenting sludges are formed. Anion exchange resins soluble in water can also be used for precipitation of cyanides. Cyanide precipitation is not useful in the case of more dilute wastes. (Main-PTT)
W86-06081

BIODEGRADATION OF ETHILENE GLYCOL,

Barcelona Univ. (Spain). Dept. of Chemical Engineering.
J. Costa, J. Soley, J. Mata, and J. Masides.
Effluent and Water Treatment Journal EWTJAG,, Vol. 25, No. 12, p 429-434, December 1985. 8 fig, 4 tab, 13 ref.

Descriptors: *Biodegradation, *Ethylene glycol, *Wastewater treatment, Kinetics, Model studies, Activated Sludge, Water treatment, Settling tank, Michaelis-Menton Model, Monod Model, Eckenfelder Model, Grau Model, Gauss-Siedel Method, Municipal wastewater.

When attempting to design a treatment plant with activated sludge, a series of kinetic parameters must be taken into account. Out of the possible kinetic models which can be used are the Michaelis-Menten model, the Monod modified model, the Eckenfelder model, and the Grau models. In this study the analytical method was chosen to determine kinetic constants. A population of microorganisms from a municipal wastewater treatment plant was acclimatized to the substrate, ethilene glycol. When the microorganisms had adapted to the environment two different objectives were achieved. First, results for a continuous experiment and secondly a population of microorganisms suitable for use in a series of batch experiments. The aim of the study was to compare the validity of the kinetic constants obtained in batch experiments with those obtained in continuous experiments. From the data and the flows studied, it can be concluded that the models which give the best results are the Monod, Grau and Eckenfelder. Not all the models most frequently used can be used to obtain trustworthy kinetic constants. It can also be concluded that it is possible to obtain, through batch experiments in a relatively short time, kinetic parameters which are just as reliable as those obtained in continuous experiments. (Main-PTT)
W86-06082

SEPARATION OF METALS IN WASTEWATER SLUDGE BY CENTRIFUGAL CLASSIFICATION,

Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
C. A. Fronk, J. B. Farrell, and W. Strachan.
Environmental Progress ENVPDI, Vol. 4., No. 4, p. 269-276, November, 1985, 6 fig, 8 tab, 9 ref.

Descriptors: *Wastewater treatment, *Separation techniques, *Sludge solids, *Metals, Centrifugation, Sludge Cake, California, Lake Tahoe, Magnesium, Phosphate, Calcium hydroxyapatite, Organic compounds.

The great bulk of municipal wastewater sludge is harmless or beneficial with toxic contaminants generally present in only trace amounts. There would be substantial benefit if these trace substances could be removed economically. In Lake Tahoe, California, it was discovered that a solid-bowl continuous decanter centrifuge with an internal helical conveyor for solids removal separated the sludge into two fractions. The primary constituent of the sludge was calcium carbonate, with lesser amounts of magnesium, phosphate, calcium hydroxyapatite, and organic solids. It was found that the calcium carbonate was concentrated in the solids in the cake, whereas the magnesium and phosphate compounds were concentrated in the solids in the centrate. Consequently, instead of just wasting a portion of the cake to bleed off impurities, the centrifuge was deliberately operated inefficiently, losing the undesirable phosphates and magnesium compounds in the centrate. The cake, which was enriched in calcium carbonate, was reburned to CaO and reused. The centrate solids were subsequently collected by a second centrifuge, using a polymer, and discarded. This procedure improved the economics of their process because the lime concentration in the reburned product was increased, calcium carbonate losses were lower, and lime makeup was reduced. The interesting results indicate that centrifugal classification might prove to be a useful and cost-effective method for removing harmful substances from sewage sludge. (David-PTT)
W86-06085

MICROBIAL ACCUMULATION OF HEAVY METALS IN WASTEWATER TREATMENT PROCESSES,

Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
J. N. Lester, and R. M. Sterritt.
Journal of Applied Bacteriology (Symposium Supplement) JABAA4, p 141S-153S, 1985. 2 fig, 8 tab, 11 ref.

Descriptors: *Wastewater treatment, *Heavy metals, *Bioaccumulation, Biodegradation, Microbial degradation, Sewage, Sludge, Effluents, Chemical precipitation, Adsorption, volatility, Toxicity.

Because heavy metals are an important group among the pollutants present in wastewaters, their significance has led to the formulation of guidelines for the regulation of agricultural use of sewage sludges contaminated with heavy metals that are produced as a result of metal removal during wastewater treatment. That proportion of the heavy metals input which is not removed in the sludge is usually discharged directly in the effluent to surface waters. Therefore, sewage effluents have a direct effect on surface water quality. In areas where indirect water re-use is practiced, with effluents contributing up to 35% of the volumetric flow of receiving rivers, the efficiency of heavy metals removal in wastewater treatment processes

is important in preventing heavy metal pollution of the receiving waters. This is especially true where these are abstracted for potable supply, since maximum permissible concentrations of heavy metals have been specified. Physicochemical mechanisms, such as adsorption, complexation and precipitation, and biological mechanisms, such as volatilization and active uptake, of heavy metal removal are discussed. Comparison of active and passive uptake in activated sludge, effects of metal toxicity, nutrient status and extracellular polymers are factors for consideration when activated sludge is being considered as a metal adsorbent. (David-PTT)
W86-06087

CONTINUOUS DECOLORIZATION OF MOLASSES WASTE WATER WITH MYCELIA OF COLIOLUS VERSICOLOR PS4A,

Tsukuba Univ. (Japan). Inst. of Applied Biochemistry.
S. Ohmomo, N. Itoh, Y. Watanabe, Y. Kaneko, and Y. Tozawa.
Agriculture and Biological Chemistry ABCHA6, Vol. 49, No. 9, p 2551-2555, September, 1985. 5 fig, 1 tab, 10 ref.

Descriptors: *Color removal, *Food processing wastes, *Wastewater treatment, *Bubbling column reactors, *Fermentation waste, Activated sludge process, Yeasts.

A process for continuous decolorization of molasses waste water by mycelia of Coriolus versicolor Ps4a was studied using waste water from a baker's yeast factory, treated by means of methane fermentation and activated sludge. Optimum effect with bare pellet-type mycelia in shaking flasks needed the addition of glucose (0.5%) and peptone (0.05%) and aerobic conditions (1 ppm of dissolved oxygen). Continuous decolorization in a bubbling column reactor showed a decolorization yield of 75% in only 20 hr at a dilution rate (D) of 0.03/hr under the optimum conditions. To extend the effect, mycelia immobilized within Ca-alginate gel were tested in a bubbling column reactor under the optimum conditions. The immobilized mycelia showed an almost constant yield (65. 7%) during continuous decolorization for 16 days at D = 0.22 hr. (Alexander-PTT)
W86-06096

THERMOPHILIC ANAEROBIC DIGESTION OF HIGH STRENGTH WASTEWATERS,

Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
W. M. Wiegant, J. A. Claassen, and G. Lettinga.
Biotechnology and Bioengineering BIBIAU, Vol. 26, No. 9, p 1374-1381 September 1986. 6 fig, 3 tab, 21 ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, *Thermophilic bacteria, Vinasse, Sludge, Effluents, Sludge digestion, Methane, Volatile acids.

The thermophilic anaerobic treatment of high-strength wastewaters (14-65 kg COD/cu m) was investigated with vinasse, the wastewater of alcohol distilleries, used as an example. Semicontinuously fed digestion experiments at high retention times revealed that the effluent quality of digestion at 55 C is comparable with that at 30 C, at similar loading rates. The amount of methane formed per kilogram of vinasse drops almost linearly with increasing concentrations. This can be attributed to increasing concentrations of inhibitory compounds, resulting in an increased of volatile fatty acid (VFA) concentrations in the effluent. The treatment of vinasse was also investigated using upflow anaerobic sludge blanket (UASB) reactors. Thermophilic granular sludge, cultivated on sucrose, was used as the seed material. The sludge required a 4-month adaptation period, during which the size of the sludge granules decreased significantly. However, the settling characteristics remained satisfactory. After adaptation, high loading and methane generation rates could be accommodated at satisfactory treatment efficiencies. As with semicontinuously fed digesters, the effluent VFA concentrations were virtually independent of the loading rates applied, indicating that the toxicity of the vinasse is more important than the loading rate in determining the efficiency of the converation of vinasse to methane. (Jones-PTT)
W86-06103

STARTUP OF ANAEROBIC DOWNFLOW STATIONARY FIXED FILM REACTORS,

National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.
K. J. Kennedy, and R. L. Droste.
Biotechnology and Bioengineering BIBIAU, Vol. 27, No. 8, p 1152-1165, August 1985. 10 fig, 7 tab, 14 ref.

Descriptors: *Reactor startup, *Wastewater treatment, *Anaerobic digestion, *Fixed film reactors, Pollution load, Chemical oxygen demand, Biofilm.

One of the serious problems limiting the application of full-scale anaerobic fixed film processes is reactor startup. To better understand startup, studies with downflow stationary fixed film reactors were conducted to characterize the effects of influent concentration, support material, and surface-to-volume ratio on biofilm development and overall reactor performance. Materials with roughened surfaces gave the best startup performance and, as expected, increased surface area in the reactors leading to more rapid increases in loading rates, and higher ultimate loadings. Soluble influent chemical oxygen demand (COD) concentrations between 5000 and 20000 mg/L increased the rate of biofilm development. Lower COD concentrations resulted in faster development of the biofilm, even though ultimate loadings were not necessarily achieved as rapidly as in reactors fed higher strength wastes. No decrease in specific activity of the biofilms in each reactor was observed as the thickness of the biofilms increased to their maximum value at the ultimate loadings. The operation of reactors fed lower strength wastes was more stable than reactors receiving higher strength feeds at comparable loadings. Biofilm yield activity, COD removals, suspended growth and activity, and other system parameters are discussed. (Author's abstract)
W86-06105

BIOLOGICAL TREATMENT SPECIFIC FOR AN INDUSTRIAL WASTEWATER CONTAINING S-TRIAZINES,

Eidgenoessische Technische Hochschule, Zurich (Switzerland). Inst. fuer Mikrobiologisches.
W. Hogrefe, H. Grossenbacher, A. M. Cook, and R. Hutter.
Biotechnology and Bioengineering BIBIAU, Vol. 27, No. 9, p 1291-1296, September 1985. 6 fig, 1 tab, 23 ref.

Descriptors: *Biodegradation, *Biological treatment, *Industrial wastewater, *Triazines, *Wastewater treatment, Nitrogen, Carbon, Temperature effects, Bacterial growth.

Mixed cultures of bacteria grew in media containing real s-triazine wastes as a nitrogen source. About 80% of the s-triazine waste could be degraded as determined by high performance liquid chromatography (HPLC) and measurements of dissolved nitrogen. This system was examined as a biological treatment for wastes from syntheses of s-triazines. It was possible to operate a small-scale system that degraded about 80% of the s-triazines in real wastes. The system utilized a mixed culture of bacteria at about 37 C in an unsterilized, open system that required little maintenance and was thus simple to operate. The culture did, however, require an added source of carbon for growth. Otherwise, little or no degradation was observed. Concentrations of salt above 3% caused a marked reduction in the growth and degradation rates. (Jones-PTT)
W86-06106

PERFORMANCE EVALUATION OF AN ANOXIC/OXIC ACTIVATED SLUDGE SYSTEM: EFFECTS OF MEAN CELL RESIDENCE TIME AND ANOXIC HYDRAULIC RETENTION TIME,

Pennsylvania Univ., Philadelphia. Dept. of Civil and Urban Engineering.
W. K. Shieh, and C. Y. Chen.
Biotechnology and Bioengineering BIBIAU, Vol. 28, No. 1, p 7-15, January 1986. 10 fig, 3 tab, 27 ref.
NSC of Taiwan, China. Contract No. NSC 72-0406-E005-01.

Descriptors: *Activated sludge, *Anoxic hydraulic retention time, *Mean cell residence time, *Wastewater treatment, Chemical oxygen demand, Biomass, Nitrogen.

A laboratory investigation has been undertaken to assess the effects of two operating parameters, mean cell residence time (MCRT) and anoxic hydraulic retention time (HRT), on the performance of an anoxic/oxic activated sludge system. The performance of the system was evaluated in terms of its chemical oxygen demand (COD), nitrogen, and biomass characteristics. An activated sludge system is capable of producing a better effluent, in terms of COD and nitrogen characteristics, when it is operated in an anoxic/oxic fashion. A longer MCRT and an adequate anoxic HRT are desirable in the operation of an anoxic/oxic activated sludge system. A uniform distribution of biomass is achievable in an anoxic/oxic activated sludge system because of the intensive recirculation/convection maintained. The provision of an anoxic zone in the aeration tank promotes a rapid adsorption of feed COD into the biomass without an immediate utilization for cell synthesis. This, in turn, results in a high microbial activity and a lower observed biomass yield in the system. A tertiary treatment efficiency is achievable in an anoxic/oxic activated sludge system with only secondary treatment operations and costs. (Jones-PTT)
W86-06107

METHANE RECOVERY FROM WATER HYACINTH THROUGH ANAEROBIC ACTIVATED SLUDGE PROCESS,

Indian Inst. of Tech., Bombay. Centre for Environmental Science and Engineering.
N. Saraswat, and P. Khanna.
Biotechnology and Bioengineering BIBIAU, Vol. 28, No. 2, p 240-246, February 1986, 9 fig, 2 tab, 19 ref.

Descriptors: *Methane recovery, *Water hyacinth, *Anaerobic digestion, *Activated sludge, *Wastewater treatment, Methane, Alkali treatment, Recycling, Cost-benefit analysis, Pretreatment of water.

The concepts of phase separation, anaerobic activated sludge processes, and alkali pretreatment have been incorporated in this investigation with the objective of developing a rational and cost-effective designs for diphasic anaerobic activated sludge systems, with and without alkali treatment, for methane recovery from water hyacinth (WH). Evaluation of process kinetics and optimization analyses of laboratory data, reveal that a diphasic system with alkali treatment could be designed with an alkali pretreatment step, followed by and open acid phase and closed methane reactor with sludge recycling for a gas yield of 50 L/kg WH/d at 35-37 C. Likewise, a diphasic system without alkali treatment, could be designed with an open reactor and sludge recycle for a gas yield of 32.5 L/kg WH/d at 35-37 C. Detailed economic analyses bring forth a greater cost-efficiency of the diphasic system without alkali treatment, and reveal that the advantage accrued in terms of higher gas yield is overshadowed by the cost of chemicals in the diphasic system with alkali treatment. (Jones-PTT)
W86-06108

HEALTH EFFECTS OF WORK AT WASTE WATER TREATMENT PLANTS: A REVIEW OF THE LITERATURE WITH GUIDELINES FOR MEDICAL SURVEILLANCE,

Boston Univ., MA. School of Medicine.
For primary bibliographic entry see Field 5C.
W86-06129

METHANE PRODUCTION FROM INDUSTRIAL WASTES BY TWO-PHASE ANAEROBIC DIGESTION,

Institute of Gas Technology, Chicago, IL. Bioengineering Research.
S. Ghosh, J. P. Ombregt, and P. Pipyn.
Water Research WATRAG, Vol. 19, No. 9, p 1083-1088, 1985. 1 fig, 9 tab, 8 ref.

Descriptors: *Industrial wastes, *Wastewater treatment, *Anaerobic digestion, *Liquid wastes, *Waste recovery, Industrial wastewater, Methane, Cost analysis, Operating costs, Stage digestion.

Although much attention has been paid to energy recovery from municipal sewage, industrial liquid waste is a larger potential source of renewable energy. In certain industrial sectors, it is possible, in theory to displace almost all of the purchased fuels by recovering the energy content of the waste in suitable forms and utilizing them within the plant. Anaerobic digestion is probably the only available process that can achieve the dual goal of energy recovery from aqueous wastes and stabilization of the pollution load. With high-COD industrial wastes, unbalanced digestion and, ultimately, process failure are encountered when attempts are made to operate conventional digesters at high loadings and short hydraulic retention times (HRT). A two-phase digestion process (the Anthane/Anodek Process) is introduced to handle overall loadings up to 12 kg COD/cu m/day and HRT's down to 13 hr affording the same methane yield as achieved at one-tenth the loading rate and ten times the HRT needed for stable operation of a high-rate digester. The superior performance of the two-phase process was proven in pilot- and full-scale operations with several high-strength industrial liquid wastes. The two-stage digester process reduces plant capital and operating costs, increases process reliability, and gives a higher energy recovery and shorter payback period. (Geiger-PTT)
W86-06148

NITRIFICATION OF AMMONIA IN WASTEWATER. FIELD OBSERVATIONS AND LABORATORY STUDIES,

Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Jacob Blaustein Inst. for Desert Research.
A. Abeliovich.
Water Research WATRAG, Vol. 19, No. 9, p 1097-1099, 1985. 2 fig, 1 tab, 8 ref.

Descriptors: *Nitrification, *Ammonia, *Wastewater treatment, *Domestic wastes, *Oxidation ponds, Bacteria, Biological wastewater treatment, Photosynthesis, Biochemical oxygen demand, Nitrates, Nitrites, Nitrogen compounds, Algae, Toxicity.

The possibility of nitrifying the ammonia present in wastewater was studied under conditions as close as possible to the conditions prevailing in oxidation ponds and wastewater reservoirs. Complete nitrification of ammonia in partially treated domestic wastewater was demonstrated in a mixed culture chemostat. The optimal detention time of water in the chemostat for maximal nitrification was 6-7 days. Total BOD and COD did not change significantly in the chemostat, but filtered BOD and COD, although still very high, dropped to about 50% of their value in the oxidation pond water. The possibility of avoiding ammonia toxicity to algae in oxidation ponds by its nitrification demonstrated on a small scale should be feasible also on a much larger scale in the field. However, the presence of nitrifying bacteria in an overloaded oxidation pond raises the question of their energy and carbon metabolism under practically anaerobic conditions. (Geiger-PTT)
W86-06150

BIOLOGICAL SULPHATE REMOVAL IN AN UPFLOW PACKED BED REACTOR,

National Inst. for Water Research, Pretoria (South Africa).
J. P. Maree, and W. F. Strydom.
Water Research WATRAG, Vol. 19, No. 9, p1101-1106, 1985. 2 fig, 4 tab, 10 ref.

Descriptors: *Wastewater treatment, *Packed beds, *Sulfates, *Sulfite liquors, *Anaerobic conditions, *Biological wastewater treatment, Anaerobic bacteria, Organic carbon, Sludge bed, Mine wastes, Sugars, Photosynthesis, Sulfur.

Mine waters and industrial effluents with high sulfate concentrations create a disposal problem in terms of excess mineralization of surface waters. The present study evaluated the performance of a packed bed reactor using various types of media for the reduction of sulfate and studied the efficiency of sulfate reduction obtained with sugar, sulfite pulp mill effluent or sewage sludge as organic carbon source. Good sulfate removal was obtained by providing anaerobic conditions on a solid medium and maintaining a low hydrogen sulfide concentration by recirculating the water through a photosynthetic reactor for sulfur production. For the removal of 1800 mg sulfate, the following amounts of potential carbon sources are required: 1.6 g sugar, 16.7 ml spent liquor from a sulfite pulp mill, or 172 ml raw sewage sludge. Heavy metals like lead and nickel are removed. The best media type seems to be hard stone, white sand and plastic media gave no results. Recirculation enhanced sulfate reduction, while the presence of light increased sulfur production. Stone media released elements such as calcium and boron under anaerobic conditions. By producing sulfur with this process instead of hydrogen sulfide as in the case in the absence of the photosynthetic reactor, the problem of the removal of hydrogen sulfide was overcome. (Geiger-PTT)
W86-06151

NITRIFICATION IN ROTATING DISC SYSTEMS - I: CRITERIA FOR TRANSITION FROM OXYGEN TO AMMONIA RATE LIMITATION,

Technical Univ. of Istanbul (Turkey). Dept. of Environmental Engineering.
I. E. Gonenc, and P. Harremoes.
Water Research WATRAG, Vol. 19, No. 9, p 1119-1127, 1985. 9 fig, 1 tab, 35 ref.

Descriptors: *Nitrification, *Biological wastewater treatment, *Ammonia, *Denitrification, *Organic matter, Nitrogen removal, Biological membranes, Separation techniques, Biological oxygen demand, Oxygen uptake, Oxygen, Wastewater treatment, Mathematical models, Heterotrophic bacteria.

Identification of the rate limiting substrate and half-order rate constants are presented on the basis of biofilm kinetics for triple substrate conditions (organic matter, ammonia and oxygen) in a rotating biological disc system. These findings have been verified by pilot-scale experiment. The transition from ammonia rate limitation to oxygen rate limitation occurs at a bulk ammonia-nitrogen concentration to bulk oxygen concentration ratio of approximately 0.4. Accordingly, oxygen is the rate limiting substrate. For most practical purposes the experiments showed that the oxygen limited half-order reaction constant in the presence of simultaneous organic matter degradation is reduced compared to nitrification alone by a factor which is a function of the growth of the heterotrophs and the nitrifiers in the biofilm. (Author's abstract)
W86-06153

COMPARATIVE DISINFECTION OF TREATED SEWAGE WITH CHLORINE AND OZONE EFFECT OF NITRIFICATION,

Technische Hogeschool Delft (Netherlands). Lab. of Sanitary Engineering.
J. G. den Blanken.
Water Research WATRAG, Vol. 19, No. 9, p 1129-1140, 1985. 5 fig, 7 tab, 56 ref.

Descriptors: *Disinfection, *Chlorine, *Ozone, *Disinfectants, *Nitrification, Bacteria, Viruses, Coliforms, Comparison studies, Wastewater treatment, Chlorination, Ozonation, Bromine, Bromides, Models, Design criteria, Pilot plants, Water treatment.

Chlorine and ozone were compared in pilot plants fed with the same activated sludge treated and filtered water. Along with physico-chemical properties, the water was analyzed for vegetative bacteria, bacterial spores, and bacterial viruses. The average chlorine and ozone dose were, respectively, 3.65 and 15.3 mg/liter of water, which were reduced to 1.79 and 0.35 mg/liter, respectively after a contact time of about 25 min. The ammonia-N concentration was used to group the data into four classes: non-nitrified water, moderately nitrified water, well nitrified water, and very well nitrified water. This classification indicated that the concentrations of most other impurities decreased with a better nitrification. Statistical analysis of the data showed that ozone was a better disinfectant than chlorine when disinfection is based upon their residual content. The degree of nitrification had a greater effect on chlorine disinfection than on ozone disinfection. During chlorination, the total residual chlorine decreased with better nitrification. During ozonation, reductions of most organisms increased slightly with better nitrification; only reductions of F-specific bacteriophages decreased. The bromide concentration affected the chemistry of chlorine and ozone and had a positive effect on chlorine and ozone disinfection of total coliforms. For most types of microorganisms the disinfection coefficients of the Selleck model and the germicidal efficiencies could be determined. (Geiger-PTT)
W86-06154

RELATION BETWEEN ACTIVATED CARBON ADSORPTION AND WATER QUALITY INDEXES,

Osaka Municipal Technical Research Inst. (Japan).
I. Abe, K. Hayashi, H. Tatsumoto, M. Kitagawa, and T. Hirashima.
Water Research WATRAG, Vol. 19, No. 9, p 1191-1193, 1985. 1 fig, 1 tab, 6.

Descriptors: *Activated carbon, *Water treatment, *Wastewater treatment, *Organic compounds, *Separation techniques, Water quality, Carbon, Bromine, Chlorine, Oxygen, Adsorption, Dissolved solids, Oxygen demand, Mathematical studies.

Adsorption by activated carbon provides a method for the purification of municipal and industrial wastewaters. In designing water purification facilities, it is useful to be able to predict the adsorbability of organic compounds. In order to estimate the adsorbability by activated carbon of organic compounds dissolved in aqueous solutions, the contribution of individual atoms to the adsorption process is calculated. The contribution of carbon, bromine and chlorine atoms is positive, while that of the oxygen atoms is negative. The contribution of hydrogen atoms is very small and that of nitrogen atoms is influenced by the kind of functional group in which they are contained. The dominant factors governing adsorption are the numbers of carbon and oxygen atoms in a molecule. The effectiveness of the activated carbon for adsorbing organic compounds dissolved in solutions can be predicted from such water quality factors as total organic carbon, total organic nitrogen, total organic halogen and total oxygen demand. (Geiger-PTT)
W86-06160

5E. Ultimate Disposal Of Wastes

HAZARDOUS WASTE CLEANUP AND DISASTER MANAGEMENT,

R. Popkin.
Environment ENVTAR, Vol. 28, No. 3, p 2-5, April 1986. 4 ref.

Descriptors: *Hazardous materials, *Environmental control, Pollutants, Love Canal, Mississippi River, Resource Conservation and Recovery Act, Public policy, Landfills.

Toxic waste is a national problem beset by a bewildering variety of scientific, legal, political, community, and industry related influences and considerations that have both positive and negative impacts. The processes both of cleaning up hazardous waste that has accumulated for decades and of preventing future accumulations will not be quick. In 1965, with the passage of the Solid Waste Dis-

posal Act, Congress first recognized the threat posed by wastes to air, water, and land resources and to human health. In 1970 the Resource Recovery Act expanded the 1965 act to promote the use of sanitary landfills. In 1976, Congress passed the Resource Conservation and Recovery Act, and federal concern was institutionalized to go beyond concerns about traditional kinds of municipal trash to face the growing body of scientific knowledge showing that wastes from chemical and other industrial processes could be dangerous to human and environmental health. The events at Love Canal were, and still are, a major motivating factor in the push for cleaning up. EPA has identified more than 18,000 dangerous waste sites and put hundreds of them on a priority action list. At the 1985 'Cities on the Beach' conference convened by the Land and Water Policy Center at the University of Massachusetts, a county water quality expert from Terrebone Parish, Louisiana, described the Mississippi River as America's biggest and longest sewer. A sampling of newspaper clippings in 3 weeks of January and February 1986 shows numerous stories about illegal dumping, demands for action, jurisdictional arguments, company objections, siting controversies, progress reports, and concern about Superfund's future from a number of states. The state of the art of hazardous waste disposal and the reluctance of communities to have hazardous waste facilities within their boundaries are also part of the problem. (Peters-PTT)
W86-05452

SUPERFUND: THE SEARCH FOR CONSISTENCY,

J. Heil, and J. Van Blarcom.
Environment ENVTAR, Vol. 28, No. 3, p 6-9, April 1986. 4 ref.

Descriptors: *Hazardous materials, *Superfund, Environmental control, Pollutants, Clean Water Act, Chemical wastes, National Priorities List, Legislation, Landfills, Standards.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund) was enacted in 1980 to provide for cleanup at sites where hazardous wastes had been abandoned or where past hazardous waste disposal practices had contaminated the environment. However, there are no standards for determining the degree of cleanup required and this absence of cleanup standards is one of the most important questions confronting the Superfund program. Four options exist: return the site to its original condition by removing all contaminants; set uniform national standards for acceptable residual levels for all chemicals and classes of chemicals found at Superfund sites; apply the best available technology; and treat immediate and significant risks on a site-by-site basis until standards are developed. Sites vary greatly in terms of the wastes involved, the populations affected, and the economic and technological factors involved. Sites on the National Priorities list represent a relatively small percentage of the nation's uncontrolled hazardous waste sites. The House and the Senate passed separate Superfund reauthorization bills in 1985. Both bills recognize the need to address the issue of cleanup standards, and the House bill included criteria that required cleanups to attain any applicable standards set under other federal environmental laws or under the water quality standards of the Clean Water Act. Neither bill, however, would require national applications of standards to all hazardous waste sites. (Peters-PTT)
W86-05453

RATING THE PERFORMANCE OF WASTE MANAGEMENT COMPANIES,

B. A. Goldman.
Environment ENVTAR, Vol. 28, No. 3, p 10-13, April 1986. 1 tab.

Descriptors: *Hazardous materials, *Groundwater pollution, *Chemical wastes, *Chemical industry, Federal regulations, State regulations, Oklahoma, Groundwater monitoring.

The Council on Economic Priorities (CEP) has prepared a study of the hazardous waste management industry to promote the proper management of hazardous wastes. The study discusses federal and state regulations currently affecting hazardous waste management, presents a guide to the technologies used to manage these wastes, and profiles individual company strengths and weaknesses. The following companies are rated: Chemical Waste Management, Inc.; CECOS International, Inc.; Ensco Inc.; Rollins Environmental Services of Louisiana; Texas Ecologists, Inc.; U.S. Pollution Control, Inc.; International Technology Corporation, and Envirosafe Services of Idaho, Inc. Grades are given for the following: groundwater route, surface water route, air route, fire and explosion, direct contact, corrective action, technology, groundwater monitoring, and insurance. The best overall performance record was that of U.S. Pollution Control, Inc., a relatively unknown Oklahoma-based company. The leaders of the commercial hazardous waste management industry are working to overcome significant problems. (Peters-PTT)
W86-05454

HEALTH ASPECTS OF HAZARDOUS WASTE DISPOSAL,

J. W. Grisham.
Environment ENVTAR, Vol. 28, No. 3, p 38-45, April 1986. 1 ref.

Descriptors: *Hazardous materials, *Chemical industry, *Landfills, *Public health, *Groundwater pollution, Trace metals, Pesticides, Chlorinated solvents, Aromatic compounds, Polychlorinated biphenyls, Hydrocarbons, Drinking water, Wells, Leaching, Clay, Sand, Gravel, Soil types.

The public has become highly suspicious of the chemical industry and has little confidence in government efforts to protect it from unknown and unseen chemical threats. The health effects of chemical wastes in more than 20,000 uncontrolled sites that contain chemicals with an enormous diversity of physical and chemical characterists are of concern. Uncontrolled sites include open dumps, landfills, bulk storage containers, and surface impoundments. The locations for these sites were usually selected for convenience and expedience. Some were appropriately built on clay soil that would retard leakage, while others were located in sandy or gravelly terrain only a few feet above the groundwater and frequently in close proximity to shallow drinking water wells. When the sites were abandoned, they were frequently left uncovered, thus increasing the likelihood of water pollution from leaching or flooding. Clay soils or organic rich soils absorb many chemicals, thus reducing the rate of release. Sand and gravel favor rapid movement of water and other liquids and do not provide good containment. Contamination of air or surface water is generally less hazardous than contamination of groundwater. Groundwater moves more slowly than surface water, with little mixing or dilution, and degradation of contaminants proceeds more slowly. Contaminated groundwater moves in a plume that may persist for decades after polluting activities have ended. The diversity of chemicals reported in drinking-water aquifers in the vicinity of chemical disposal sites include chlorinated solvents, aromatic hydrocarbons, pesticides, trace metals, and polychlorinated biphenyls. (Peters-PTT)
W86-05455

WATER SUPPLY AND WASTE DISPOSAL ON PERMANENT SNOWFIELDS,

Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 5F.
W86-05473

WINNING STRATEGIES FOR LAND APPLICATION,

Environmental Protection Agency, Washington, DC. Office of Municipal Pollution Control.
J. M. Walker.
Biocycle BCYCDK, Vol. 27, No. 5, p 40-44, May-June 1986. 2 fig, 18 ref.

Descriptors: *Sludge disposal, *Land Application, *Sewage sludge, *Public relations, Washington, District of Columbia, Public participation, Management planning, Farmers.

The essential requirements for successful implementation of a land application scheme are discussed, with emphasis on the experiences obtained in the Washington, District of Columbia, metropolitan area. A primary reason for acceptance of sludge spreading has been years of good research by many cooperating groups that has shown that the practices are safe and cost-effective. Efforts to reduce public resistance include giving out accurate information, closely following permit and regulatory requirements, keeping the trucks, equipment, and roads very clean, hiring local residents and respected firms for hauling, spreading, and analyses, meeting one-on-one with farmers, county officials, the farm bureaus, and others, informing them in a timely manner of what is occurring, and effectively correcting a misleading statement. (Rochester-PTT)
W86-05544

RADIOACTIVITY LEVELS IN MUNICIPAL SLUDGE,

Battelle Columbus Div., OH.
S. Brauning, B. Cornaby, J. McGinnis, and E. Lomnitz.
Biocycle, BCYCDK, Vol. 27, No. 5, p 48-51, May-June 1986. 1 fig, 1 tab, 12 ref.

Descriptors: *Sewage sludge, *Radionuclides, Iodine-131, Cesium-137, Radon-226, Americium-241, Nuclear powerplant, Fallout, Drinking water, Smoke detectors, Computerized databases, Telephone survey.

Results of a US Environmental Protection Agency-sponsored study on radioactive compounds present in sludge are summarized. A search of computerized databases and a telephone survey were conducted to obtain data. The data varied widely with respect to purpose of collection, types of sludge samples, number of samples, and radionuclides analyzed. The four radionuclides reported most often were 131I, 137Cs, 226Ra, and 241Am. The 131I, which is widely used in nuclear medicine, was reported in sludge from 11 sewage treatment plants; concentrations ranged from 0.045 to 180 picoCuries/g. 137Cs was reported from four plants, and apparently came from a nuclear facility and fallout. 241Am was found at two locations; it had been released to the sewage systems by manufacturers of foils used in smoke detectors. 226Ra in sludge was found at four plants, in areas where 226Ra was present naturally in high concentrations in drinking water. (Rochester-PTT)
W86-05546

CHEMICAL COMPOSITION OF VEGETABLES GROWN ON AN AGRICULTURAL SOIL AMENDED WITH SEWAGE SLUDGES,

West Virginia Univ., Morgantown. Div. of Plant and Soil Sciences.
For primary bibliographic entry see Field 5B.
W86-05552

TIME-DEPENDENT CHANGES IN SOLUBLE ORGANICS, COPPER, NICKEL, AND ZINC FROM SLUDGE AMENDED SOILS,

Washington State Univ., Pullman. Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W86-05554

TRANSPORT OF 60CO BETWEEN WATER AND SEDIMENTS IN A SMALL SHIELD LAKE,

Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
For primary bibliographic entry see Field 5B.
W86-05563

ADVANCED SUBTERRANEAN WASTEWATER TREATMENT PLANT,

Hollandse Eilandenen Waarden Wastewater Authority, Dordrecht (Netherlands).

For primary bibliographic entry see Field 5D.
W86-05603

EFFICIENCY OF O3 AND BAC IN THMS REMOVAL,
Harbin Civil Engineering Inst. (China). Water Pollution Control Lab.
For primary bibliographic entry see Field 5D.
W86-05606

GEOLOGICAL AND HYDROGEOLOGICAL ASPECTS FOR PLANNING AND OPERATION OF DOMESTIC AND INDUSTRIAL WASTE DEPOSITS,
Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Ingenier- und Hydrogeologie.
For primary bibliographic entry see Field 5G.
W86-05726

EFFECTS ON CATTLE FROM EXPOSURE TO SEWAGE SLUDGE,
Metropolitan Denver Sewage Disposal District No. 1, CO.
For primary bibliographic entry see Field 5C.
W86-05808

LEACHING TESTS OF HEAVY METALS STABILIZED WITH PORTLAND CEMENT,
New Hampshire Univ., Durham. Dept. of Civil Engineering.
W. Shively, P. Bishop, D. Gress, and T. Brown.
Water Pollution Control Federation Journal JWPFA, Vol. 58, No. 3, p 234-241, March 1986. 5 fig, 2 tab, 38 ref.

Descriptors: *Leaching, *Heavy metals, *Portland cements, *Waste disposal, Waste stabilization.

The leaching of heavy metals sludges was substantially reduced by solidification and stabilization with Portland cement. All samples passed the EPA EP-toxicity test and are not considered to be hazardous waste. Heavy metals in the sludges were diluted by the stabilization process, aided by salts, hydroxides, and cement compounds. Release of heavy metals proceeded in three phases during the sequential extractions, with peak releases for the more soluble metals occurring as the pH dropped to less than 6.0. Substantial amounts of heavy metals remained in the silicon-rich solids after the alkalinity had been neutralized during the 15 extractions. Arsenite, calcium, and cadmium were leached primarily during the extractions. Most of the aluminum, chromium, iron, and lead were leached during the acetic and nitric acid digestions. Acid flux was strongest during these digestions, and leaching probably was related to cement paste decomposition. Silicon remained in the solids after the other elements had leached and was dissolved by the hydrofluoric acid digestion. The stabilized wastes exhibited large buffering capacities. Alkalinity was provided primarily by calcium hydroxide in the cement paste, and is integral to part of the stabilization process. (Doria-PTT)
W86-05896

LIQUID-PHASE MASS TRANSFER COEFFICIENTS FOR SURFACE IMPOUNDMENTS,
Arkansas Univ., Fayetteville.
For primary bibliographic entry see Field 5D.
W86-05900

SPILLAGE OVER AN INCLINED EMBANKMENT,
Norges Tekniske Hoegskole, Trondheim. Dept. of Physics and Mathematics.
For primary bibliographic entry see Field 2E.
W86-05968

SAN FRANCISCO OUTFALL: THE CHAMP,
Parsons, Brinckerhoff, Quade and Douglas, Inc., San Francisco, CA.
G. J. Murphy, and Y. Eisenberg.
Civil Engineering (ASCE), Vol. 55, No. 12, p. 58-61, December 1985. 4 fig, 2 ref.

Descriptors: *Outfalls, Sanitary sewage, Storm water, *San Francisco, San Andreas Fault, Outfall sewers, Wastewater outfall, California, Construction, San Francisco Bay.

San Francisco's $150 million sewage outfall has been designed to cross the San Andreas Fault. Midway in construction, 26 ft. waves swept away the dredging and conduit-laying barge, delaying work for 17 months. Begun in 1981, the project is expected to be completed July 1986. The 23,400 foot long outfall is one of the world's longest. The length was dictated by the need to carry the city's sewage effluent into deep water sufficiently remote from the Golden Gate so that undesirable particulates would not be carried back into the San Francisco Bay. Though reaching out 4 1/2 miles, the outfall does not pass under water deeper than 80 feet. Rather than sitting on the ocean floor it is buried in a protective trench at least 25 feet deep. (David-PTT)
W86-06080

ENVIRONMENTAL MOVEMENT OF INDICATOR BACTERIA FROM SOIL AMENDED WITH UNDIGESTED SEWAGE SLUDGE,
Oklahoma Univ. Health Sciences Center, Oklahoma City.
For primary bibliographic entry see Field 5B.
W86-06083

DESIGN AND IMPLEMENTATION OF GROUNDWATER RECOVERY SYSTEMS,
Underground Resource Management, Inc., Austin, TX.
For primary bibliographic entry see Field 5G.
W86-06084

CIRCULATION INDUCED BY COASTAL DIFFUSER DISCHARGE,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-06114

CADMIUM AND NICKEL IN MAINSTREAM PARTICULATES OF CIGARETTES CONTAINING TOBACCO GROWN ON A LOW-CADMIUM SOIL-SLUDGE MIXTURE,
New York State Coll. of Agriculture and Life Sciences, Ithaca.
For primary bibliographic entry see Field 5B.
W86-06119

METHANE PRODUCTION FROM INDUSTRIAL WASTES BY TWO-PHASE ANAEROBIC DIGESTION,
Institute of Gas Technology, Chicago, IL. Bioengineering Research.
For primary bibliographic entry see Field 5D.
W86-06148

IMPACT ON PHYTOPLANKTON POPULATIONS OF SEWAGE DISCHARGES IN THE SARONIKOS GULF (WEST AEGEAN),
Institute of Oceanographic and Fisheries Research, Athens (Greece).
For primary bibliographic entry see Field 5C.
W86-06152

5F. Water Treatment and Quality Alteration

ANALYSIS OF PIPE BREAKAGE IN URBAN WATER DISTRIBUTION NETWORKS,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
A. J. Kettler, and I. C. Goulter.
Canadian Journal of Civil Engineering CJCEB, Vol. 12, No. 2, p 286-293, June 1985. 6 fig, 3 tab, 18 ref.

Descriptors: *Cast-iron pipes, *Asbestos-cement pipes, *Pipe failure, *Conveyance structures, *Urban areas, *Water distribution, Pipe diameter, Aging, Joint failure, North America.

The rates of pipe breakage with increasing pipe diameter and times were investigated using data from a number of North American cities (New York, Philadelphia in the U.S.; St. Catharines and Winnipeg in Canada). Failure rates for cast-iron pipe decreased with increasing diameter. Changes in pipe failure rates for the various modes of failures were examined in detail. Asbestos-cement and cast-iron pipe overall failure rates increased with time, but for different reasons. Analysis of modes of failure showed that joint failure predominated in cast-iron pipe systems with bolted and universal joints, whereas circumferential cracking was the predominant mode of failure in asbestos-cement pipe systems. These results provide indications of problem areas that should be considered in the costing/design of pipe networks. (Rochester-PTT)
W86-05469

CONCRETE WATER TANKS IN ONTARIO,
Slater (W.M.) and Associates, Inc., Toronto (Ontario).
For primary bibliographic entry see Field 8F.
W86-05472

WATER SUPPLY AND WASTE DISPOSAL ON PERMANENT SNOWFIELDS,
Cold Regions Research and Engineering Lab., Hanover, NH.
S. C. Reed, J. R. Bouzoun, and W. T. Tobiasson.
Canadian Journal of Civil Engineering CJCEB, Vol. 12, No. 2, p 344-350, June 1985. 2 fig, 10 ref.

Descriptors: *Snowfields, *Ice cap, *Glaciers, *Water supply, *Wastewater disposal, Cold regions, Greenland, Antarctica, Foundation failure, Temperature.

The snow and glacial ice on permanent snowfields must serve as both the water source and the receptacle for wastes for any human habitation. In addition, the snow also serves as the support media for any structural foundations and hence the thermal aspects of water supply and waste disposal can be critical. Most activity has occurred on the ice caps of Greenland and Antarctica and has ranged from small transient field parties to large permanent facilities in continuous use for >25 yr. Novel procedures to insure the reliable production of good quality water include the Rodriquez well, which uses a heat source together with a pump to create a deep well by melting ice in place. Unless there is contamination during the collection or production processes, water quality can be expected to be very high. Water requirements range from 8 L/day as a 'survival' ration to 200 L/day/person for very comfortable permanent habitation. The various methods of wastewater disposal that have been used at temporary camps and permanent stations are described, including the results from studies that defined the fate of the wastewater following its discharge to the snow. Such definition is important to insure protection of the water supply as well as the thermal integrity of any foundation. (Rochester-PTT)
W86-05473

RECOVERY OF COLIFORMS IN THE PRESENCE OF A FREE CHLORINE RESIDUAL,
Grand Rapids Water Dept., MI.
J. T. Wierenga.
Journal of the American Water Works Association JAWWA5, Vol. 77, No. 11, p 83-88, November 1985. 2 fig, 2 tab, 15 ref.

Descriptors: *Coliforms, *Chlorination, Grand Rapids, Michigan, Bacteria, Potable water, *Water treatment, Water distribution.

Despite the presence of a free chlorine residual, significant numbers of coliforms were recovered from the Grand Rapids, Mich., distribution system during the summers of 1982 and 1983. The first incident appears to have been caused by entry of a slug of contamination into the water supply. The second incident involved persistent recoveries of apparent regrowth organisms and paralleled previous incidents reported by other utilities. All genera of organisms isolated from the Grand Rapids

system have been isolated previously from a filtered chlorinated water supply. The subsequent discovery of several defects in the Grand Rapids water supply system points out the need to determine the source of such organisms. Mechanisms by which coliforms may survive in chlorinated distribution systems include encapsulation, association with tubercle material, cell clumping, adhesion to pipe surfaces or suspended particulate matter, and lodgment within suspended solids. Utilities should be alert to the fact that coliforms can be recovered from filtered distribution waters despite the presence of a free chlorine residual. Until otherwise demonstrated, such recoveries should be treated as a serious contamination problem. A free chlorine residual and bacterial sampling should not be relied upon to ensure safe potable water. (Main-PTT)
W86-05514

HYDRAULIC BEHAVIOR OF DECLINING RATE FILTRATION,

Hidrosan Ltd., Bogata (Columbia).
For primary bibliographic entry see Field 5D.
W86-05515

EFFECTS OF CHLORINE AND AMMONIA APPLICATION POINTS ON BACTERICIDAL EFFICIENCY,

Southern California Metropolitan Water District, Los Angeles.
E. G. Means, III, T. S. Tanaka, D. J. Otsuka, and M. J. McGuire.
Journal of the American Water Works Association JAWWA5, Vol. 78, No. 1, P 62-69, January 1986. 10 fig, 3 tab, 51 ref.

Descriptors: *Chlorination, *Chlorine, *Chloramines, *Disinfection, *Ammonia, Water treatment, Bacteria, Potable water, Bioindicators, Pilot plants.

Data in the literature uniformly designate chloramines as less effective for the disinfection of water for potable use than free residual chlorine. Many treatment plants in the United States that use chloramines successfully apply ammonia first. The bactericidal efficiences of chloramines produced by (1) concurrent addition of chlorine and ammonia to the influent water, (2) prechlorination followed by addition of ammonia, and (3) preammoniation were compared with that of free residual chlorine during pilot testing. Coliform bacteria were found to be a poor indicator of the relative ability of the application schemes to disinfect water. Concurrent chlorine and ammonia application, prechlorination followed by addition of ammonia, and free residual chlorination generally produced low total bacteria counts in the pilot-plant effluent. Preammoniation resulted in the highest frequency of elevated total bacteria count in the plant effluent. It is concluded that chloramination effectively reduces trihalomethanes and, with long contact times, provides disinfection that is statistically equivalent to that observed with free chlorine. In addition, chloramines will reduce bacteria in the treatment plant effluents to acceptable levels. (Main-PTT)
W86-05516

LEGIONELLA CONTAMINATION OF A PREOPERATIONAL TREATMENT PLANT,

Ohio State Univ., Columbus. Dept. of Microbiology.
L. Voss, K. S. Button, R. C. Lorenz, and O. H. Tuovinen.
Journal of the American Water Works Association JAWWA5, Vol. 78, No. 1, p 70-75, January 1986.

Descriptors: *Legionella, *Water treatment facilities, Pipes, Bacteria, Chlorination, Flushing, Plumbing.

A study of the distribution of Legionella in a newly constructed water treatment facility found Legionella pneumophila (serogroup 1) in both hot- and cold-water lines. The contamination was monitored by bacterial enumeration of samples collected from various sites in the building and from disassembled plumbing fixtures. Legionella colonies were generally detectable within 48 to 72 h. Repeated flushing and hyperchlorination were inadequate as decontamination procedures. Legionella and total counts decreased upon flushing. However, Legionella was still detectable at low densities even after 60 min of flushing. Legionella was detected within 2 days of chlorination. Apparently, the organism had colonized areas not accessible to chlorination and flushing. The data indicate that Legionella is able to proliferate in cold-water systems reaching densities at least as great as those found in hot-water systems. Thus, it is not confined to habitats with elevated temperatures. (Main-PTT)
W86-05517

DIATOMACEOUS EARTH FILTRATION OF GIARDIA CYSTS AND OTHER SUBSTANCES,

Microfloc Products, New Brighton, MN. Johnson Div.
K. P. Lange, W. D. Bellamy, D. W. Hendricks, and G. S. Logsdon.
Journal of the American Water Works Association JAWWA5, Vol. 78, No. 12, p 76-84, January 1986. 7 fig, 3 tab, 19 ref.

Descriptors: *Diatomaceous earth, *Filtration, *Giardia, *Water treatment, Giardiasis, Bacteria, Turbidity, Coliforms, Pilot plants, Horsetooth Reservoir, Chlorination, Disinfection, Alum, Hydraulic loading.

Research was conducted to ascertain the suitability of diatomaceous earth (DE) filtration for the removal of Giardia cysts. Removal of turbidity, total coliform bacteria, standard plate count bacteria, and particles were also determined. The experimental program utilized a diatomaceous earth pilot plant that had a 1-sq ft (0.09-sq m) septum. The Giardia concentrate was added to a filter feed tank. The tank was filled with Horsetooth Reservoir water. Testing began with precoating, and the recycle was continued for 10 min while 10 mg chlorine/L was added for disinfection. The chlorine was purged and sampling started after a 30-min washout period. Pilot-tests resulted in virtually 100% removal of Giardia lamblia cysts for both coarse and fine grades of diatomaceous earth over a wide range of conditions. Removals of turbidity and total coliform bacteria were functionally dependent on the grade of diatomaceous earth. Alum coating increased removal rates. Increased hydraulic loading caused a decrease in efficiency. (Main-PTT)
W86-05518

POTABLE WATER TREATMENT WITH O3 AND BAC IN CHINA,

Harbin Civil Engineering Inst. (China). Water Pollution Control Lab.
B. Wang, J. Tian, and J. Yin.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 10, p 371-378, October 1985. 17 fig, 1 tab, 17 ref.

Descriptors: *Water treatment, *Ozone, *Potable water, *China, *Biological activated carbon, Sand filtration, Ozonation, Filtration, Turbidity, Color removal, Ammonia, Odor control, Organoleptic properties, Taste, Sulfides, Phenols.

The drinking water sources of Harbin City, the capital of Heilongjiang Province, have been heavily polluted by municipal and industrial wastewaters from upstream cities and itself. A pilot plant was designed and installed to conduct comparative studies of four different treatment processes: direct filtration and adsorption through activated carbon column (BAC process), preozonation-biological activated carbon process (O3 + BAC process), preozonation-rapid sand filtration process (O3 + SF process) and preozonation-rapid sand filtration-biological activated carbon process (O3 + SF + BAC). Several kinds of polluted water from different sources were used in the experiment. It was found that all four treatment processes tested in the study were capable of effectively removing turbidity-forming substances when reasonable backwashing periods were maintained. Of the four processes, the process O3 + BAC exhibited higher removal efficiency than the BAC process. BAC and O3 + SF are not very effective in removing color. Both O3 + BAC and O3 + SF + BAC removed color at much higher efficiencies. All treatment processes were effective in removing taste and odor caused by sulfides, ammonium, phenols, and other odorous pollutants. Hydrogen sulfide and ammonium can be removed by ozonation. When the groundwater is aerated, the ferrous ions can be easily oxidized into hydroxides. Ozone was effective in oxidizing Mn2+ ions into MnO(OH)2. The MnO(OH)2 flocs are removed from water through filtration. The processes O3 + BAC and 03 + SF + BAC are most effective in removing organic matter with effluent concentrations below the WHO standard for drinking water. (Main-PTT)
W86-05521

UPGRADING THE SALEM MUNICIPAL WATER SYSTEM FROM 1914 TO 1984,

Linenthal Eisenberg Anderson, Inc., Boston, MA.
P. D. Guertin, P. Knowlton, and P. S. Niman.
New England Water Works Association Journal, Vol. 99, No. 3, p 236-248, September, 1985. 3 fig, 4 ref.

Descriptors: *Salem, *Municipal water, *Water supply systems, Massachusetts, Pumping stations, Reservoir, Water mains, Wenham Lake, Folly Hill, Reservoir, Water treatment facilities, Cost analysis, Construction, Reservoirs.

The Salem water system, one of the oldest public supplies in the northeast, undertook its last major renovation after 1914. Designers of the system placed great emphasis on being able to provide water to the city under catastrophic conditions. Major factors causing problems are a result of: excessive residence time in the distribution system; lack of turnover in the 10 million gallon Folly Hill reservoir; long deadend lines; and miles of old unlined cast iron mains. The City decided to upgrade a portion of the core system. The proposed work was: to construct a new high lift pumping station at Wenham Lake with operational control combined with the filtration plant; clean and line and/or reinforce the cast iron feed main from the Wenham Lake Pumping Station to the Folly Hill Reservoir; and refurbish the Folly Hill Reservoir. These major system improvements will increase the realiability and quality of water, but will not be adequate to significantly improve the distribution system. The new pumping station and filtration plant will share a primary meter allowing a reduction in the demand rate classification and save the combined facilities approximately $22,000 per year in power costs. It was deemed desirable to investigate the feasibility of constructing a new parallel 24 inch diameter main between the Wenham Lake pumping station and the Folly Hill reservoir, providing the city with two mains, either of which is capable of delivering the total demand. Proposed water main construction will permit reduced operating costs, improved system reliability and improved water quality. In order to insure adequate turnover, the inlet/outlet system of the reservoir was redesigned to eliminate stagnant areas. The project described will provide a new strong main core feed delivery system into the distribution grid. However, much work needs to be done to bring the grid to 1984 conditions. (Main-PTT)
W86-05538

PROVISIONS IN DESIGN AND MAINTENANCE TO PROTECT WATER QUALITY FROM ROOF CATCHMENTS,

Dundee Univ. (Scotland).
G. Michaelides, and R. Young.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 1/2, p 1-11, June 1985. 2 fig, 25 ref.

Descriptors: *Rain water, *Domestic water, *Design considerations, *Rooftop collection, Water tanks, Waterproofing, Water quality control, Water pollution prevention, Water treatment, Water storage, Plumbing.

Design considerations applicable to collection of water for domestic use from rooftop catchments are discussed under the following headings: roofing materials, paint, other precautions (relative to

trees, birds, aerial spraying, debris), inflow system, separation (of early and later rainwater), locating storage tanks, storage tank construction materials and methods (cement-based materials, lead, copper, iron, steel, brick or stone, plastic lining, asphalt or tar waterproofing), screening and covering, preventing entry of settled particles, cool storage conditions, design considerations in water delivery, maintenance of water quality (collection and inflow systems, storage systems), effectiveness and realization of measures, and water treatment. (Rochester-PTT)
W86-05581

ENTROPY ANALYSIS OF WATER AND WASTEWATER TREATMENT PROCESSES,

National Inst. for Environmental Studies, Tsukuba (Japan). Water and Soil Environment Div.
For primary bibliographic entry see Field 5D.
W86-05582

TREATMENT OF WATER CLOSET FLUSH WATER FOR RECYCLE AND REUSE,

Texas Univ. at Arlington. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-05585

MATHEMATICAL MODELLING OF MOBILE BED FILTRATION WITH CONTACT FLOCCULATION-FILTRATION ARRANGEMENT,

Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
S. Vigneswaran, and C. Visvanathan.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 9, p 309-314, September 1985. 5 fig, 2 tab, 7 ref.

Descriptors: *Mathematical models, *Flocculation, *Filtration, *Water treatment, *Mobile bed filtration, Pretreatment of water, Mathematical analysis, Mathematical equation.

Conventional water treatment plants employ unit operations such as rapid mixing, flocculation, sedimentation, filtration and disinfection. All these pretreatment units lead to an increase in operational costs. Direct filtration is one of the recent developments in the filtration processes, and is being developed with only screening, coagulant addition, rapid mixing and flocculation prior to filtration. Contact flocculation-filtration is a further modification of direct filtration, with only a chemical holding tank in the pretreatment unit, allowing large savings to be achieved with this process. The main drawback is the clogging of the filter bed. Mathematical formulation of suspended solids removal in contact-flocculation filtration is complex since both flocculation and suspended solids removal occur within the filter bed itself. In this study, a mathematical formulation was developed for contact flocculation-filtration incorporating the flocculation phenomena in ideal conditions. This model can be modified for contact-flocculation filtration by taking into account the flocculation phenomena within the filter bed. This requires the development of empirical equations relating the floc size variation with velocity gradient and flocculation time form laboratory-scale flocculation experiments with the same suspension used for filtration. The value alpha sub p beta appearing in the model was found to increase in filtration velocity instead of remaining constant. This is the main drawback of the model. (Khumbatta-PTT)
W86-05607

APPLICATION OF CONTAMINANT ARRIVAL DISTRIBUTIONS TO THE SIMULATION AND DESIGN OF HYDRAULIC DECONTAMINATION MEASURES IN POROUS AQUIFERS,

Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
For primary bibliographic entry see Field 5G.
W86-05728

WATER REUSE: PROBLEMS AND SOLUTIONS,

For primary bibliographic entry see Field 5D.
W86-05800

EFFECT OF PHOSPHORUS LIMITATION DECREE IN DETERGENTS ON THE PHOSPHORUS LOAD IN MUNICIPAL WASTEWATER- COMPARISON OF CALCULATED AND MEASURED DATA,

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
For primary bibliographic entry see Field 5G.
W86-05820

CHARACTERISTICS OF DYSGONIC, HETEROTROPHIC BACTERIA FROM DRINKING WATER,

Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
For primary bibliographic entry see Field 5A.
W86-05827

1980-81 DROUGHT IN SOUTHEASTERN NEW YORK,

State Univ. of New York at Albany. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 3B.
W86-05831

INFLUENCE OF OZONE, OXYGEN, AND CHLORINE ON BIOLOGICAL ACTIVITY ON BIOLOGICAL ACTIVATED CARBON,

Pretoria Univ. (South Africa). Dept. of Water Utilisation Engineering.
J. van Leeuwen, E. M. Nupen, and P. A. du T. Carstens.
Ozone: Science and Engineering OZSEDS, Vol. 7, No. 4, p 287-297, Fall 1985. 2 fig, 3 tab, 9 ref.

Descriptors: *Ozone, *Water treatment, *Activated carbon, *Effluents, Biodegradability, Oxygen, Chlorine, Preozonation, Potable water, Secondary wastewater treatment, Activated sludge.

Activated carbon treatment has proved to be indispensable ensuring a high quality of potable water from secondary effluents. A reduction in cost was investigated by using ozone as a oxidative pretreatment. The ozone not only removed part of the organic load, but also let to a more favorable biological activated carbon (BAC) performance. Ozone, particularly, in a dosage of about 5 mg/L, promoted increased biodegradability, while chlorine and oxygen (in addition to the dissolved oxygen already in the effluent) had no significant effect. (Adams-PTT)
W86-05840

ZOOFLAGELLATES IN AN ANAEROBIC WASTE STABILIZATION POND SYSTEM IN MEXICO,

Universidad Nacional Autonoma de Mexico, Mexico City.
For primary bibliographic entry see Field 5D.
W86-05843

COMMITTEE REPORT: CURRENT PRACTICE IN BACTERIOLOGICAL SAMPLING.

American Water Works Association, New York.
American Water Works Association Journal JAWWA5, Vol. 77, No. 9, p 75-81, September 1985. 16 tab, 5 ref.

Descriptors: *Water sampling, *Bacterial analysis, Water analysis, Monitoring, Water quality, Water conveyance.

A survey of AWWA utility members indicated that there is a great variability among sampling programs for microbiological monitoring of water distribution systems. This variability includes the number of samples collected, the use of check samples, the patterns of sample collection over the area of the distribution system and over time, and the sample collection and laboratory examination techniques. The variability in these factors suggests that the significance of the monitoring results may be quite different among the various water distribution systems. Since little research has been conducted on the various elements of a sampling program, there is as yet no basis for specifying the sampling procedures for an ideal bacteriological monitoring program. (Doria-PTT)
W86-05871

PRIVATIZATION OF WATER SYSTEMS IN FRANCE,

Compagnie Generale des Eaux, Paris (France).
For primary bibliographic entry see Field 6E.
W86-05872

SELECTING POLYMERIC FLOCCULANTS FOR WATER TREATMENT,

Calgon Corp., Pittsburgh, PA. Water Management Div.
R. P. Kim.
Public Works, Vol. 116, No. 9, p 108-110, September 1985. 2 fig.

Descriptors: *Water treatment, *Polymers, *Flocculation, Sludge, Resins, Ion exchange, Wastewater treatment.

Today, there is a wide choice of cationic, anionic and nonionic polymeric chemicals with electrical charge densities ranging from the high through medium and low for flocculants. Polymer molecules range in chain length from short to long and are available as commercial products as solutions, emulsions, or granules. Product activities go from as low as 4% in some 1 liquids to nearly 100 percent in dry forms. Polymer manufacturers can also provide physical blends customized for specific applications. Each of these polymer products was first developed in response to a specific need in some industry,and have been in use as flocculants for about 30 years. They also have been used to dispense sludge in steam/condensate systems. In this application, anionic polymers are used to impart negative charges to sludge particles and boiler surfaces so particles repel each other, remain finely dispersed and do not adhere to metal surfaces. (Khumbatta-PTT)
W86-05876

PRIVATE SECTOR FINANCING FOR WATER SYSTEMS,

Young (Arthur) and Co., Seattle, WA.
For primary bibliographic entry see Field 6C.
W86-05882

REMOVING TRIHALOMETHANES BY PACKED-COLUMN AND DIFFUSED AERATION,

Environmental Science and Engineering, Inc., Gainesville, FL.
L. J. Bilello, and J. E. Singley.
American Water Works Association Journal JAWWA5, Vol. 78, No. 2, p 62-71, February 1986. 19 fig, 6 tab, 8 ref.

Descriptors: *Trihalomethanes, *Packed columns, *Diffused aeration, *Aeration, *Water treatment, Chlorinated hydrocarbons, Flow rate, Chloroform, Water pollution treatment.

The performance of packed-column and diffused aeration for removing trihalomethanes from drinking water was related to water source, water temperature, contaminant concentration, and other process variables. Data obtained from this study were compared with theoretical predictions and with the results of previous feasibility studies. Total trihalomethane removals of >95% can be achieved in a packed column regardless of the initial concentration. The effectiveness of a packed column is dependent on the water temperature, the packing medium used, the surface loading rate of the water, the depth of packing, and the volumetric ratio of the air flow to water flow. Performance was not shown to be related to the concentration of the contaminant (chloroform) or to the water source. In addition to providing conceptual design data for packed columns, pilot-scale studies were useful in optimizing operational conditions and choosing cost-effective designs. Data obtained for pilot columns are representative of the perform-

ance of large full-scale systems, as demonstrated by comparison of the results for a 6-in (15.2-cm) column with those for a 15-in (38-cm) column. Diffused aeration improved with increased water depths and air-to-water ratios. Distribution of air along a channel was not an advantage over a single air source. Performation was related more to the volume of air applied than to how it was applied. (Doria-PTT)
W86-05885

STABILITY OF TURBIDITY IN RAW WATER AND ITS RELATIONSHIP TO CHLORINE DEMAND,

Environmental Protection Agency, Cincinnati, OH. Hazardous Waste Engineering Research Lab.
E. L. Katz.
American Water Works Association Journal JAWWA5, Vol. 78, No. 2, p 72-75, February 1986. 1 fig, 6 tab, 11 ref.

Descriptors: *Turbidity, *Raw water, *Chlorine demand, *Stability, Physical properties, Chemical properties, Water analysis, Organic carbon, Nitrogen, Kjeldahl procedure, Suspended solids, Inorganic compounds.

In this study, 160 raw water samples collected throughout the United States were examined for chlorine demand, turbidity, and other chemical parameters to determine whether these parameters were interrelated. Other parameters such as total organic carbon, total Kjeldahl nitrogen, volatiles, suspended solids, particle size, and inorganics were also examined. Eighty-nine of these samples were also examined over a one-week period to determine the stability of the turbidity values over one, three, and seven days. Changes in turbidity appeared in about 77% of the samples in the range of 0.05-1 ntu, 90% of samples in the 1-5 ntu range, and 96% of those > 5.0 ntu. In some cases, more than a 200% change in turbidity is reflected. In 63% of the samples, changes of 10-50% were seen. Because of this strong indication of the inherent instability of turbid raw water samples, measurements of samples should be done immediately on site to ensure accuracy of turbidity readings. (Doria-PTT)
W86-05886

NATURE OF ORGANICS REMOVED DURING TREATMENT OF MISSISSIPPI RIVER WATER,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
M. J. Semmens, and A. B. Staples.
American Water Works Association Journal JAWWA5, Vol. 78, No. 2, p 76-81, February 1986. 2 fig, 10 tab, 27 ref.

Descriptors: *Water quality, *Mississippi River, *Organic compounds, *Water treatment, Quality control, Chlorinated hydrocarbons, Potable water, Trihalomethanes, Alum, Activated carbon, Adsorption.

A single sample of Mississippi River water was subjected to various pretreatments (lime softening, alum coagulation, and iron-polymer coagulation) before being applied to columns of granular activated carbon. Samples of water were taken from the raw river water, after pretreatment, and after carbon adsorption. The organic content of these samples was characterized, and the following conclusions can be drawn from analysis of the data collected. Forty percent of the organic content of the sample was characterized hydrophobic and 60% hydrophilic. The molecular weight distributions of the river water for the fractions <1K, 1-10K, 10-100K, and >100K, were 23, 50, 10, and 17% respectively, based on total organic carbon analysis. Pretreatment with alum, iron-polymer, or lime resulted in the removal of mainly acidic and neutral organic compounds. Hydrophobic organics were slightly better removed than hydrophilic compounds, and coagulation gave better organics removal, but lime addition was not optimized for organic removal. Total trihalometahane (THM) formation potential analyses were conducted on polarity fractions for the differently treated waters. Trihalomethane precursors were almost evenly split between the hydrophobic and hydrophilic fractions in the raw water. There appeared to be significant differences in the character and distribution of THM precursors between lime-treated and coagulated waters before and after granular activated carbon (GAC) treatment. Higher molecular weight organics were most effectively removed during pretreatment. Lower molecular weight organics were effectively reduced by GAC. After lime treatment, the concentration of low molecular weight organics (<1K) appeared to increase (by approximately 30%). The effluent samples from GAC contained mainly low molecular weight hydrophilic neutral and acidic organics. (Doria-PTT)
W86-05887

DESORPTION OF ORGANICS FORMED ON ACTIVATED CARBON,

Stanford Univ., CA. Dept. of Civil Engineering.
E. A. Voudrias, V. L. Snoeyink, and R. A. Larson.
American Water Works Association Journal JAWWA5, Vol. 78, No. 2, p 82-86, February 1986. 2 fig, 3 tab, 17 ref. NSF Grant CEE81-10024.

Descriptors: *Desorption, *Activated carbon, *Organic compounds, *Water treatment, Chlorine, Phenols, p-benzoquinone, 2,4-dichlorophenol, 4,4'-dihydroxyphenyl, Pretreatment of water, Alkalinity.

Free and combined chlorine react with phenols adsorbed on granular activated carbon (GAC) to produce a series of oxidation products not formed in the absence of carbon. Some of these products, e.g., p-benzoquinone, can be displaced into the effluent by the introduction of a strongly adsorbed compound, e.g., 2,4-dichlorophenol, into the influent. Other products, e.g., 4,4'-dihydroxybiphenyl, are very strongly adsorbed and occupy adsorption sites that would otherwise be available for removal of other compounds in the influent. In vie of these findings and the other undesirable effects of prechlorination (e.g., corrosivity for low alkalinity water and formation of taste- and odor-causing compounds, trihalomethanes, and other chlorinated organics), processes resulting in the contact of chlorine with GAS need to be reevaluated. (Doria-PTT)
W86-05888

ECONOMICS OF PUMPING AND THE UTILIZATION FACTOR,

Melbourne Univ., Parkville (Australia).
For primary bibliographic entry see Field 8B.
W86-05975

POTENTIAL FORMATION OF BROMOPHENOLS IN BARCELONA'S TAP WATER DUE TO DAILY SALT MINE DISCHARGES AND OCCASIONAL PHENOL SPILLS,

Sociedad General de Aguas de Barcelona (Spain).
F. Ventura, and J. Rivera.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 2, p 219-225, February 1986, 4 fig, 20 ref.

Descriptors: *Water pollution sources, *Drinking Water, *Chlorination, *Mine Drainage, *Salt mines, *Bromophenols, Phenol, Bromide, Water treatment, Barcelona, Spain.

Three million people obtain drinking water from the Llobregat River which is contaminated with bromide (1-3.5 mg/l) and phenol (0.1-6 mg/l) from salt mines upstream. Brominated trihalomethanes were the predominant species in the drinking water. The bromophenols may be formed during normal chlorination at the water treatment plant. (McFarlane-PTT)
W86-05997

WAYS TO TACKLE THE VOC PROBLEM,

Culp/Wesner/Culp, Cameron Park, CA.
B. R. Willey, and R. B. Williams.
Water/Engineering and Management WENMD2, Vol. 133, No. 5, p 20-23, 45, May 1986. 4 fig, 2 tab, 14 ref.

Descriptors: *Aeration, *Adsorption, *Volatile organic compounds, *Potable water, *Water treatment, Granulated activated carbon, Powdered activated carbon, Management planning.

Management strategies and treatment strategies for removing volatile organic compounds (VOCs) from potable water include aeration (diffused aeration, spray aeration, and waterfall aeration), adsorption (with granular activated carbon or powdered activated carbon), and combination aeration-adsorption. Design considerations in air stripping, air stripping process selection, competitive adsorptive, desorption, effect of type of VOC on packed column design, and properties of selected VOCs are discussed, and a diagram for selection of a feasible aeration process for control of VOCs is included. (Rochester-PTT)
W86-06038

METER STANDARDS HAVE BECOME A BARRIER TO PROGRESS,

Badger Meter, Inc., Milwaukee, WI.
For primary bibliographic entry see Field 7B.
W86-06039

CITY USES TWO-PRONGED STRATEGY FOR THM CONTROL,

Chesapeake Dept. of Public Utilities, VA.
A. Dwarkanath, and M. P. Robinson.
Public Works PUWOAH, Vol. 7, No. 6, p 60-61, June 1986. 1 tab.

Descriptors: *Trihalomethanes, *Air stripping, *Chlorine dioxide, *Water treatment facilities, Virginia, Cost analysis, Chloramines, Aeration, Screening matrix, Full-scale performance, Jaegar tripack.

Both immediate and long-term solutions to the problem of excessive trihalomethanes (THM) in the distribution system at Chesapeake, Virginia, are described. To meet the short-term goal of immediate reduction of THM, chlorine dioxide was employed, resulting in a drop of THM concentration from about 600 ppb to 20 ppb. A survey was conducted of alternative treatment methods and four approaches (chlorine dioxide, chlorine dioxide and chloramines, air stripping, and diffused aeration) were evaluated in a screening matrix using the following criteria: bacteriological quality assurance, THM reduction efficiency, residual effects, cost, operation and maintenance, ease of implementation, and regulatory acceptance. The two highest scores were for air stripping and diffused aeration. The former was chosen because of lower costs, and a full-scale air stripping system consisting of two 14-ft diameter prestressed concrete towers and associated pumps, blowers, and a 400,000-gal clearwell were built. The towers are packed with Jaegar Tripack, and have successfully kept THM levels within Virginia's regulatory limits since commencing operations in May 1985. (Rochester-PTT)
W86-06043

TREATMENT METHODS TO BE STUDIED AT DEMONSTRATION PLANT,

New York City Bureau of Water Supply.
E. Scheader, E. Bryant, A. Shanmugam, and G. Fulton.
Public Works PUWOAH, Vol. 117, No. 6, p 66-69, June 1986.

Descriptors: *New York City, *Croton Lake, *Testing procedures, *Pilot plants, Ozonation, Diatomaceous earth filtration, Reservoirs, Water distribution, Demonstration plant.

An ongoing program to construct a demonstration plant to investigate treatment of New York City's Croton water supply is described, including significant process test features and the overall Croton improvement program. Topics discussed include: watershed yield and quality, Croton supply rates, significant process test features (ozonation, diatomaceous earth (DE) filtration, carbon adsorption, DE recovery, DE flow abrasion tests, baseline filtration, alternative treatment tests, and mobile pilot facilities), site work on the Jerome Park Reservoir, distribution works in Manhattan, the New

Croton Lake gate house, and program schedule. Completion of the Croton program should provide an updated, flexible system capable of contributing to the water supply needs of New York City for the next century. (Rochester-PTT)
W86-06045

IS OZONE THE SOLUTION TO YOUR WATER TREATMENT PROBLEMS,

Buck, Siefert and Jost, Inc., Paramus, NJ.
D. J. Pulice.
Public Works PUWOAH, Vol. 117, No. 6, p 81-84, 138, June 1986. 4 fig, 1 tab.

Descriptors: *Water treatment, *Water treatment facilities, *Ozone, Ozonation, Pilot plants, Activated carbon, Biological filters, Cost-benefit analysis, Electrical equipment, Oxygen, Potable water, Drinking water.

The properties of ozone; pilot plants; ozone generators and generation; and specifications of ozone systems as related to use as a water treatment methods are discussed. If ozone is being considered as a method for water treatment, the first step should be to construct a pilot plant designed for continuous operation. The type and complexity of the plant depends on the specific water treatment problems and the results anticipated from ozone treatment. The pilot plant can also include a high-rate filter and secondary ozonation, possibly followed by a granular activated carbon filter or self-generating biological activated carbon filter. The pilot plant helps in gathering specific information as to the amount of ozone required (applied dosage) to satisfy treatment requirements and also to obtain other treatment parameters. All ozone generators work on the same basic principal, that of passing dry air through a corona discharge created by the application of high voltage and frequency across an air gap. Following passage of the air through the corona discharge (here limited to 15 KV), it is filtered, compressed, cooled, and stored (following dessication). Specifications concerning raw water characteristics, and ambient air design systems is that of cost vs. benefit, when considering start-up costs, maintenance costs, ozone generating costs, etc. (Lantz-PTT)
W86-06047

HOUSTON OPTS FOR WATER PLANT EXPANSION,

Dannenbaum Engineering Corp., Houston, TX.
W. H. Ahrens.
Public Works PUWOAH, Vol. 117, No. 6, p 86-87, June 1986.

Descriptors: *Houston, *Water treatment facilities, *Construction, *Design, Wetlands, Sludge disposal, Texas, San Jacinto River, Trinity River.

Rationale, layout and operation, construction and architectural treatment, water source and treatment, and environmental impact are discussed with reference to the expansion of the East Water Purification Plant in Harris County, Texas. This 100-million gal/day improvement, which involves a 60-inch diameter raw water line, a canal turnout and forebay, two 50-million gal/day treatment units, three 12.5-million gal prestressed concrete tanks, a sludge processing system, low lift transfer and distribution pump stations, and filter and chemical feed systems, will serve the city of Houston. Water sources are the San Jacinto River and the Trinity River. Wetlands and waters on the plant site will be left undeveloped, but an adjacent 110-acre site will be used for sludge disposal. When the project is completed, the initial increase in the city water supply will be 75%, with an ultimate 115% increase if expansion options are carried out. (Rochester-PTT)
W86-06048

CLEANING NEW PIPING SYSTEMS,

Professional Piping Services, Inc., Land O'Lakes, FL.
For primary bibliographic entry see Field 8C.
W86-06050

REMOVING GIARDIA CYSTS FROM LOW TURBIDITY WATERS BY RAPID RATE FILTRATION,

Scientific Research Council, Baghdad (Iraq).
M. Y. Al-Ani, D. W. Hendricks, G. S. Logsdon, and C. P. Hibler.
American Water Works Association Journal JAWWA5, Vol. 78, No. 5, p 66-73, May 1986. 9 fig, 3 tab, 9 ref.

Descriptors: *Giardia cysts, *Low turbidity waters, *Rapid rate filtration, *Water treatment, Coliform bacteria, Chemical pretreatment, Turbidity, Pilot plants, Pretreatment of water, Coagulation.

Although Giardia cysts are widespread in all kinds of waters, their occurrence in low turbidity waters is of special concern because of problems associated with the rapid rate filtration of these waters. Pilot-plant studies showed that when effective chemical pretreatment is employed in combination with rapid rate filtration, removals of turbidity, total coliform bacteria, and Giardia cysts from low turbidity waters may be greater than 80, 99.9, and 99.9% respectively. Proper coagulation, however, requires the careful selection of chemicals and dosages. It was also observed that for waters having turbidity levels <1 ntu, percent reduction of turbidity can serve as a surrogate indicator of the removal of Giardia cysts. (Main-PTT)
W86-06060

REMOVAL OF DISSOLVED ORGANIC CARBON BY COAGULATION WITH IRON SULFATE,

Clarkson Univ., Potsdam, NY. Dept. of Biology.
R. L. Sinsabaugh III, R. C. Hoehn, W. R. Knocke, and A. E. Linkins III.
American Water Works Association Journal JAWWA5, Vol. 78, No. 5, p 74-82, May 1986. 11 fig, 8 tab, 43 ref.

Descriptors: *Water treatment, *Organic carbon, *Coagulation, *Iron sulfate, Virginia, Ferric sulfate, Settling, Neutral compounds, Chlorine, Organohalide.

Charge, solubility, and molecular-size characteristics of dissolved organic carbon in raw and treated water from a Virginia reservoir were investigated to determine the types of organic compounds removed by ferric sulfate, coagulation, and settling. All three parameters influenced removal of dissolved organic carbon. Larger molecules were more readily precipitated than smaller ones. Ionic compounds were more effectively removed than neutral compounds. Hydrophilic and hydrophobic organics were preferentially removed over compounds of intermediate solubility. Two main groups of organic halide precursors were identified. Fulvic acids were the dominant presursors in raw water; they reacted rapidly with chlorine and had high specific yields, but were readily precipitated. Low-molecular-weight neutral compounds were the dominant precursor group remaining in treated waters. These molecules reacted more slowly with chlorine and had lower organohalide yeilds. (Author's abstract)
W86-06061

ION EXCHANGE FOR THE REMOVAL OF NITRATE FROM WELL WATER,

Environmental Protection Agency, Cincinnati, OH.
R. P. Lauch, and G. A. Guter.
American Water Works Association Journal JAWWA5, Vol. 78, No. 5, p 83-88, May 1986. 5 fig, 10 tab, 5 ref.

Descriptors: *Ion exchange, *Nitrate, *Well water, *Water treatment, McFarland California, Brine, Operating costs, Capital costs, Maintenance.

A 1-mgd (3.8-ML/d) ion exchange plant was built in McFarland, Calif., to remove excess concentrations of nitrate from one of the city's supply wells. Data are reported for semiautomatic mode of operation, during which time the plant has performed satisfactorily. Nitrate has been reduced to less than 10 mg as nitrogen/L and brine has been eliminated from the product water. Total costs for the plant, including capital and operations and maintenance, were 24.2 cents/1000 gal. (Main-PTT)
W86-06062

INFLUENCE OF PH ON THE REMOVAL OF ORGANICS BY GRANULAR ACTIVATED CARBON,

Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
M. J. Semmens, G. E. Norgaard, G. Hohenstein, and A. B. Staples.
American Water Works Association Journal JAWWA5, Vol. 78, No. 5, p 89-93, May 1986. 5 fig, 2 tab, 15 ref.

Descriptors: *Hydrogen ion concentration, *Organics compounds, *Granular activated carbon, *Water treatment, Coagulation, Flocculation, Ultraviolet absorbance, Trihalomethanes, Pretreatment of water.

The extent of organics removal achieved by coagulation is limited. Granular activated carbon (GAC) treatment may be required if low concentrations of organics are desired in the treated water. Samples of Mississippi River water were mixed rapidly enough to create a vortex. The appropriate coagulant dose was added by pouring a known volume of stock solution into the vortex of a sample. Following rapid mixing, the mixer was replace with a flocculator. Following flocculation, the contents of the tank settled for 1 h. The settled water was pumped through a trimedia filter. The pretreated water was pumped downward through carbon columns. The column effluent flowed into collection chambers which were sampled twice a day. Total organic carbon (TOC) and ultraviolet absorbance were measured. Trihalomethane (THM) concentrations were measured by solvent extraction and gas chromatography. Operation at low pH improved the performance of the GAC columns and resulted in lower organic concentrations in the effluent. For an effluent value of 1 mg TOC/L, the operating capacity of a carbon column can be increased by a factor of 400 to 500% by reducing the pH of adsorption from 8.7 to 5.0. THM precursor removal showed the same trend as TOC removal. The reduction of organics by coagulation improves dramatically as the pH is decreased to 5. The combined effects of pH on coagulation and on adsorption highlight the need for effective pH control. (Main-PTT)
W86-06063

TECHNICAL NOTE: BIOLOGICAL REMOVAL OF AMMONIA AT ROXANA, ILLINOIS,

Baxter and Woodman, Inc., Crystal Lake, IL.
J. Crooks, V. L. Snoeyink, M. D. Curry, and M. L. Reynolds.
American Water Works Association Journal JAWWA5, Vol. 78, No. 5, p 94-95, May 1986. 3 fig, 1 tab, 7 ref.

Descriptors: *Iron, *Ammonia, *Drinking water, *Water treatment, Roxana, Illinois, Algae, Reaction basin, Upflow clarifier, Nitrogen, Chlorination.

The use of an upflow clarifier to remove oxidized iron from drinking water at Roxana, Ill., resulted in the development of a population of nitrifying organisms that converted ammonia to nitrate. A much lower chlorine dose could then be used to achieve a free chlorine residual in the water entering the distribution system. Proper use of such technology should lead to better quality drinking water, possibly at lower cost. (Main-PTT)
W86-06064

ANALYSIS OF DRINKING WATER FOR THE DETECTION OF TRIHALOMETHANES,

University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
For primary bibliographic entry see Field 5A.
W86-06075

HEALTH EFFECTS OF WORK AT WASTE WATER TREATMENT PLANTS: A REVIEW OF THE LITERATURE WITH GUIDELINES FOR MEDICAL SURVEILLANCE,
Boston Univ., MA. School of Medicine.
For primary bibliographic entry see Field 5C.
W86-06129

RELATION BETWEEN ACTIVATED CARBON ADSORPTION AND WATER QUALITY INDEXES,
Osaka Municipal Technical Research Inst. (Japan).
For primary bibliographic entry see Field 5D.
W86-06160

5G. Water Quality Control

HAZARDOUS WASTE CLEANUP AND DISASTER MANAGEMENT,
For primary bibliographic entry see Field 5E.
W86-05452

SUPERFUND: THE SEARCH FOR CONSISTENCY,
For primary bibliographic entry see Field 5E.
W86-05453

HEALTH ASPECTS OF HAZARDOUS WASTE DISPOSAL,
For primary bibliographic entry see Field 5E.
W86-05455

WINNING STRATEGIES FOR LAND APPLICATION,
Environmental Protection Agency, Washington, DC. Office of Municipal Pollution Control.
For primary bibliographic entry see Field 5E.
W86-05544

BACTERIOLOGICAL QUALITY OF SELECTED BACKCOUNTRY DRINKING WATER SOURCES IN PISGAH NATIONAL FOREST,
Winthrop Coll., Rock Hill, SC. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W86-05547

DRINKING WATER SUPPLY MANAGEMENT: AN INTERACTIVE APPROACH,
Environmental Protection Agency, Cincinnati, OH. Water Engineering Research Lab.
J. A. Goodrich, and R. M. Clark.
Journal of Environmental Systems, Vol. 15, No. 1, p 1-18, 1985-86. 6 fig, 9 tab, 7 ref.

Descriptors: *Water quality control, *Carbon tetrachloride, *Policy making, *Drinking water, *Interactive systems analysis, *QUAL-II model, *Industrial wastes, *Contamination, Mathematical model, Organic chemistry, Fluid dynamics, Kanawha River, West Virginia, Ohio River, Geography.

In February 1977, a massive discharge of carbon tetrachloride into the Kanawha River in West Virginia threatened much of the Ohio River valley and contaminated drinking water potentially affecting over 1 million consumers. This episode heightened the awareness of consumers and decision-makers alike to the relationship between wastewater discharges and drinking water consumption. This article examines the results of a study motivated by the carbon tetrachloride spill and examines interactions between industrial discharges and drinking water supplies. The mechanism used to study the wastewater discharge-water supply intake interaction was the water quality/quantity simulation model QUAL-II. This model was used to provide a framework to bring together the diverse elements of mathematical modeling, fluid dynamics, organic chemistry, and geography to create an interactive systems analysis approach that can have an impact on public policy on drinking water. (Author's abstract)
W86-05575

ENVIRONMENTAL IMPACT ANALYSIS IN WATER POLLUTION CONTROL,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
J. P. Lumbers.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 3, p 177-187, July 1985. 2 tab, 15 ref, 2 append.

Descriptors: *Environmental impact analysis, *Water quality standards, *Guidelines, *Percentile water quality standards, Systems analysis, Pollution control, Policy making.

The need for wide-ranging environmental impact analysis to guide the establishment of water quality objectives and the associated effluent discharge standards is discussed. The particular problems associated with water pollution control are identified, including: multiple and conflicting demands, multiple parameter objective specifications, the stochastic and time-varying nature of the system, secondary and tertiary effects, and time-delay. Current environmental impact analysis techniques are described and discussed and it is concluded that none are yet able to satisfy fully the problem posed by the formulation and implementation of water pollution control strategies. The application of percentile water quality standards is discussed briefly and some of the principal difficulties are outlined. Comments are made on the use of water quality indices. (Author's abstract)
W86-05591

ENVIRONMENTAL BIOTECHNOLOGY AND THE WATER INDUSTRY,
Watson Hawksley, London (England).
J. M. Sidwick.
Effluent and Water Treatment Journal EWTJAG, Vol. 25, No. 8, p 272-275, August 1985. 7 ref.

Descriptors: *Environmental biotechnology, *Water treatment, *Microorganisms, Wastewater treatment, Microbial degradation, Cultures, England.

Scientists and technologists working within the water industry are progressively accepting the fact that they are biotechnologists. This article is an attempt by one to put environmental biotechnology into perspective, and to persuade at least some of the doubters to join the converted. Biotechnology was identified as an integrated entity some time after the discovery of DNA, in an attempt to become more widely recognized with sophisticated developments. In a report to the Biotechnology Directorate of the Science and Engineering Research Council, five principal areas for the application of biotechnology to waste treatment were identified: 1) the improvement of existing systems by the application of more basic bioscience and more biochemical engineering; 2) new sensors and automation; 3) use of mutent strains and genetically engineered microorganisms; 4) new catalysts and novel reactor designs; and 5) recovery of useful products from wastes. Areas where research should be conducted were identified as the microbiology and biochemistry of: 1) basic characteristics of the main species involved, and further study of, unusual biochemical or genetical features; 2) pellet formation and colonization of carrier surfaces; 3) micro-microbial ecology of mixed cultures; 4) inhibition effects; 5) thermophilic and psychrophilic systems; 6) micronutrients; 7) production of stable inocula using defined mixed cultures; and 8) production of stable inocula using preadapted mixed cultures. (Khumbatta-PTT)
W86-05604

NEW POSSIBILITIES AND METHODS OF IN SITU GROUNDWATER TREATMENT IN GRAVEL SAND AQUIFERS,
I. Radcenko, and J. Hauskrecht.
IN: Improvement of Methods of Long Term Prediction of Variations in Groundwater Resources and Regimes due to Human Activity, IAHS Publication No. 136. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 121-126, 1 fig, 1 tab, 7 ref.

Descriptors: *Groundwater pollution, *Water treatment, *Water quality control, *Water quality management, *Aeration, Biological treatment, Groundwater mining, Iron, Manganese, Hydrocarbons, Sand aquifers, Biological oxidation, Oxidation, Water pollution treatment, Alluvial deposits.

An economically effective method and equipment for the combined direct treatment of groundwater containing over-limit concentrations of iron, manganese, and hydrocarbons in water-bearing gravel-sand alluvial deposits are described. The fundamental objects of the proposed HYDRO-OXIRING system are: a pair of wells, one of which functions as a collecting well from which raw or contaminated groundwater is pumped, and the other, an exploitation well, from which the treated water is conveyed to the consumption center; aeration equipment allowing the degasification of volatile substances as well as the aeration of the original groundwater; and a horizontal infiltration structure of an open type realized in the form of a ring around the exploitation well. In the HYDRO-OXIRING system, only natural hydrochemical reactions and biological processes are active. Using the groundwater treatment simultaneously with the HYDRO-OXIRING system, a hydraulic self-protection of the exploitation well is achieved. (See also W86-05645) (Geiger - PTT)
W86-05658

LARGE-SCALE EXPERIMENT OF IN SITU BIODEGRADATION OF HYDROCARBONS IN THE SUBSURFACE,
Ingenieurbuero Dr. Ing. G. Bjornsen, Kobenz (Germany, F.R.).
G. Battermann.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 983-991, 6 fig, 6 ref.

Descriptors: *Biodegradation, *Hydrocarbons, *Groundwater, *Drinking water, Groundwater pollution, Groundwater movement, Aquifers, Aromatic compounds, In situ biodegradation, Potable water, Rhine River, West Germany.

Subsurface water was contaminated by hydrocarbons in the industrial area of a city in the Upper Rhine valley. Extensive impermeable layers divide several sandy aquifers. The upper aqifer consists of an 8 to 10 m thick layer of sand, containing some silt and clay beds. Below this aquifer is the 'Upper Clay' layer, 10 to 30 m thick, which inhibits spreading contamination to deeper aquifers. During the period of contamination, the groundwater level was approximately 5 m below the land surface, and the saturated thickness of the aquifer was 4 to 5 m. There was a slight gradient from west to east towards a municipal waterworks 500 m to the east. The wells of the waterworks plant tap the deeper aquifers. From hydrogeological investigations it is known that in the vicinity of the waterworks the deeper aquifers are recharged by the upper aquifer. Ten years ago, large amounts of aromatic hydrocarbons were detected in the upper aquifer during the clean-up of an oil spill, indicating that after hydrocarbons in-phase from a sandy aquifer have been removed, large amounts of hydrocarbons remain in the pore spaces. If these include highly water-soluble aromatic compounds, their transport can endanger drinking water supplies. One possible means of removal of the hydrocarons is by biodegradation. The results of a large-scale field experiment with in situ biodegradation are reported. The results show the applicability of this method. (See also W86-05679) (Lantz-PTT)
W86-05715

PREVENTION OF ACCUMULATING NITRATES FROM AGRICULTURAL SOURCES IN GROUND WATERS (PREVENTION DE L'ENRICHISSEMENT DES EAUX SOUTERRAINES EN NITRATES D'ORIGINE AGRICOLE),
Ministere de l'Agriculture, Paris (France). Service de l'Hydraulique.
M. Delavalle.

IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1005-1014, 2 ref.

Descriptors: *Nitrates, *Agricultural chemicals, *Groundwater pollution, France, Nitrogen, Water pollution prevention, Fertilizers, Manure.

The nitrate content of underground waters is appreciably increasing in several areas of France, where cropping and stock breeding have been strongly intensified recently. Each year, about 500,000 tons of N2 are added to the existing quantities of nitrate. That trend will be brought under control by preventive measures, mainly by the widespread use of a method of previsional balances of fertilization, taking into account the spreading of liquid manure. (See also W86-05679) (Author's abstract)
W86-05717

POTABLE GROUNDWATER SUPPLIES AND LOW-COST SANITARY ENGINEERING: HOW COMPATIBLE,

Institute of Geological Sciences, Wallingford (England). Hydrogeology Unit.
S. S. D. Foster.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1029-1041, 4 fig, 6 ref.

Descriptors: *Groundwater pollution, *Potable water, *Sanitary wastewater, *Water costs, Sewage bacteria, Septic wastewater, Water quality management, Water quality, Groundwater potential, Nitrogen, Organic compounds, Viruses.

In developing countries, groundwater is being increasingly used, since it is normally the cheapest and safest source of a potable water supply. Most commonly involved are large numbers of production boreholes of simple design, tapping comparatively shallow water table aquifers, and providing individually small, untreated and unmonitored supplies, vulnerable to pollution from the land surface. Improvements in sanitation are widely and urgently needed in these countries. It is becoming accepted that low cost technologies can be effective and are more appropriate where purely domestic effluents are involved. These include: 1) on-site excreta disposal units, such as the ventilated pit and pour-flush latrines, and 2) wastewater treatment in unlined stabilization lagoons, where waterborne domestic sewerage systems already exist, prior to discharge to surface waters or, especially in arid regions, to reuse for agricultural irrigation or for basin groundwater recharge. Principal groundwater pollution hazards are identified as: 1) pathogenic bacteria and viruses, 2) nitrogen species and salinity, and 3) trace organics. In general terms, it is concluded that for a given hydraulic and pollutant loading: 1) the depth to the groundwater table and the character of the strata in the unsaturated zone, are the principal factors controlling the degree of penetration of pathogens and biodegradable organics into groundwater, and 2) the amount of dilution by regional flow, local recharge and effluent fluid, are the dominant factors controlling the final concentration of nitrates and the more persistent trace organics in groundwater. However, it remains difficult to quantify the groundwater pollution risk for a sufficiently wide variety of hydrogeological conditions. A more detailed understanding of these problems, coupled with improved design, careful siting, and integrated planning of the installations involved, are required to reduce the groundwater pollution hazard. (See also W86-05679) (Lantz-PTT)
W86-05719

UNDERGROUND PURIFICATION CAPACITY,

Hessisches Landesamt fuer Bodenforschung, Wiesbaden (Germany, F.R.).
A. Golwer.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1063-1072, 2 fig, 10 ref.

Descriptors: *Underground purification, *Surface-groundwater relations, *Infiltration, *Percolation, Dilution, Sedimentation, Groundwater movement, Adsorption, Evaporation, Chemical precipitation, Hydrolysis, Photolysis, Transformation, Oxidation, Reduction, Decomposition, Saturation zone, Aeration zone.

The purification capacity of the underground is an important component of the natural regulation processes in ecological systems. This purification capacity consists of natural physical (dilution, sedimentation, flow, diffusion, adsorption and evaporation), chemical (precipitation, hydrolysis, photolysis, transformation, oxidation and reduction), and biological (decomposition) reactions which return contaminated subsurface water to its original condition and extensively or completely remove the environmental chemicals which have, to some extent, penetrated below the earth's surface. This capacity is significantly affected by transport processes in both the saturated and unsaturated zones, as well as by hydrogeological structural conditions. (See also W86-05679) (Lantz-PTT)
W86-05722

GEOLOGICAL AND HYDROGEOLOGICAL ASPECTS FOR PLANNING AND OPERATION OF DOMESTIC AND INDUSTRIAL WASTE DEPOSITS,

Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Ingenier- und Hydrogeologie.
K. H. Heitfeld, L. Krapp, and H. Dullmann.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1121-1135, 4 fig, 11 ref.

Descriptors: *Industrial wastes, *Domestic wastes, *Waste management, *Waste storage, *Waste dumps, Water quality management, Groundwater quality, Soil sealants, Artificial sealants, Drainage systems.

Central domestic and industrial waste deposits require detailed site investigations, effective protection measures for the groundwater and control during operation. Quantity and type of site investigations have to be adapted to local requirements. In any case borings, permeability tests (in situ and laboratory) and long-term water level observations are required. Protective sealing measures of different kinds which have been tested are: 1) naturally tight soils with artificial drainage; 2) natural soils with artificial compaction and drainage; 3) artificial sealing with single layers of mineral matter, bitumen tar, asphalt, bitumen strips, and/or platomer and elastomer blankets; 4) vertical sealing walls with a small underground diaphragm, a normal underground diaphragm, a prefabricated underground diaphragm, or a grouting curtain, and 5) double sealing blankets or walls with an intercalated drainage layer. Aspects of economy with respect to seepage quantities are very important because treatment of contaminated waters means a permanent operation cost factor. (See also W86-05679) (Lantz-PTT)
W86-05726

APPLICATION OF CONTAMINANT ARRIVAL DISTRIBUTIONS TO THE SIMULATION AND DESIGN OF HYDRAULIC DECONTAMINATION MEASURES IN POROUS AQUIFERS,

Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau.
W. Kinzelbach, and J. Herzer.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1147-1158, 4 fig, 1 tab, 4 ref.

Descriptors: *Groundwater pollution, *Groundwater decontamination, *Arrival distributions, *Hydraulic decontamination, *Porous aquifers, Pumping wells, Interception wells, West Germany, Model studies, Simulation analysis, Tetrachloroethylene.

With a growing number of groundwater pollution cases from waste disposal sites as well as accidental releases of pollutants the need for groundwater decontamination is increasing. Hydraulic decontamination by pumping wells is of interest wherever excavation is not feasible. The design of an hydraulic decontamination measure aims at removing as much pollutant as possible, by pumping as little water as possible. The concept of arrival distributions is applied to the assessment and design of pumping wells (interception wells) operated to remove contaminants from a polluted aquifer. The model calculations are illustrated by the simulation of a decontamination measure carried through in a case of groundwater pollution by tetrachloroethylene in Southern Germany. The approximations used by the method are discussed. (See also W86-05679) (Lantz-PTT)
W86-05728

GROUND-WATER POLLUTION BY NITRATE,

Bremer Umweltinstitut fuer die Analyse und Bewertung von Schadstoffen (Germany, F.R.).
U. Lahl, B. Zeschmar, B. Gabel, R. Kozicki, and A. Podbielski.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1159-1170, 2 fig, 3 tab, 15 ref.

Descriptors: *Groundwater pollution, *Nitrates, *Water quality control, Drinking water, West Germany, Fertilizers, Water supply, Manure, Groundwater management.

Groundwater pollution usually occurs unnoticed and is often detected very late, because sample collection is only possible by installing several observation wells. Supra-regional screening of groundwater quality in West Germany, is mainly based on monitoring the more than 6,000 water plants which exploit groundwater, and the nearly 2 million private wells for drinking water. The well depth for small water plants (less than 100,000 cu m/a) and private wells in most cases lies between 3 and 10 meters. Therefore they are extraordinarily sensitive to pollution, since the protecting soil layer is often relatively thin. Based on analytical data from three different institutes, the pollution of groundwater with nitrate in West Germany is quantitatively discussed. Strategies for nitrate reduction and groundwater protection are proposed, such as: 1) the avoidance of nitrate input in water production areas, by restricting the use of fertilizers in these areas, 2) the mixing of water burdened heavily with more or less not-burdened water, and 3) supra-regional connection of water supplies. (See also W86-05679) (Lantz-PTT)
W86-05729

PRESENT STATE AND PERSPECTIVES OF REGULAR GROUND-WATER QUALITY MONITORING IN SLOVAKIA,

Slovak Hydrometeorological Inst., Bratislava (Czechoslovakia).
M. Matuska, and D. Remenarova.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1185-1192, 1 fig, 2 tab.

Descriptors: *Groundwater pollution, *Water quality standards, *Water quality monitoring, *Czechoslovakia, Drinking water, Water supply, Networks, Long-term planning, Mathematical studies, Water management. Water resources management.

Human activities cause general deterioration of the environment which also has an impact on the quality of the groundwater, used in Slovakia mostly as drinking water resources for the population. At present, as much as 70% of the public water supply network is fed from groundwater resources. For this reason an observational network is being organized in Slovakia. An evaluation of the long-term changes in ground-water quality will be performed every 5 years. The methods of

mathematical statistics which process the data obtained from the observational network and other information about the territory (polluters, hydrogeology of the territory) will be used to consider the general trends in changes of groundwater quality. Proposals of measures for the improvement of groundwater quality and its protection will represent one part of the evaluation. Results of the long-term groundwater quality monitoring, as well as the above mentioned proposals of measures will be used by state authorities in their preventive or punitive activities. (See also W86-05679) (Lantz-PTT)
W86-05731

HYDROCHEMICAL MAPS AS BASIC INFORMATION FOR THE PROTECTION OF GROUNDWATER,

Grosser Erftverband, Bergheim (Germany, F.R.).
For primary bibliographic entry see Field 7C.
W86-05732

WATER QUALITY OBJECTIVES, DISCHARGE STANDARDS AND FUZZY LOGIC,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
P. W. Jowitt, and J. P. Lumbers.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 241-250, 12 ref.

Descriptors: *Water quality control, *Water management, *Water quality management, *Water allocation, Fuzzy models, Model studies, Standards, Rivers, Water quality standards.

Optimal allocation of water resources requires an agreed basis for discussing what is an acceptable water quality. Developments in the establishment and interpretation of water quality specifications are discussed. It is argued that percentile water quality standards and sensible definitions of water quality failure are often inconsistent. Rigid water quality specifications cannot account for complex and ill-defined pollutant interactions and conflicting water use objectives, but need to be qualified by linguistic statements. The use of fuzzy set theory is explored in relation to both the formulation and the interpretation of water quality specifications. (See also W86-05750) (Author's abstract)
W86-05774

OPTIMUM ALLOCATION OF WATER RESOURCES SUBJECT TO QUALITY CONSTRAINTS,

University of the Witwatersrand, Johannesburg (South Africa).
D. Stephenson.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 299-305, 2 fig, 3 tab, 4 ref.

Descriptors: *Water quality control, *Water demand, *Water allocation, Model studies, Water distribution, Cost allocation.

A method for allocating water resources economically is described. It relies on linear constraints and transportation-type programming. Quality constraints are considered in making allocations within the transportation programming tableau. This simple technique is not computer oriented. The method allows water from many sources (remote, purified wastewater, water of impaired quality) to be used for suitable purposes. It is also applicable to the operation and management of water distribution systems. (See also W86-05750) (Cassar-PTT)
W86-05779

DESIGN MANUAL: NEUTRALIZATION OF ACID MINE DRAINAGE,

Penn Environmental Consultants, Inc., Pittsburgh, PA.
For primary bibliographic entry see Field 5D.
W86-05789

GROUNDWATER CONTAMINATION FROM HAZARDOUS WASTES,

Princeton Univ., NJ. Water Resources Program.
For primary bibliographic entry see Field 5B.
W86-05794

RANGELAND WATERSHED WATER BUDGET AND GRAZING CATTLE WASTE NUTRIENT CYCLING,

Oklahoma Agricultural Experiment Station, Stillwater.
For primary bibliographic entry see Field 5B.
W86-05796

COSTS ESTIMATES FOR CONTROL OF COMBINED SEWER DISCHARGE TO MARINE BAYS AND ESTUARIES, ADDENDUM TO 1982 NEEDS SURVEY.

Environmental Protection Agency, Washington, DC. Office of Water Program Operations.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-171652, Price codes: A02 in paper copy, A01 in microfiche. Report No. EPA 430/9-83-001, March 1, 1983. 37 p, 2 fig, 1 tab, 3 append.

Descriptors: *Cost analysis, *Wastewater pollution, *Bays, *Estuaries, *Combined sewer overflows, Legislation, Legal aspects, Water quality standards, Water pollution prevention, Costs.

This report was submitted in compliance with Amendment 29 of the conference Report on the FY 1983 Appropriations for HUD and Independent Agencies (Conference Report No. 92-549, Public Law 97-272). This legislation also appropriated $30 million for control of combined sewer overflows (CSOs) affecting marine waters. The separate marine CSO fund was authorized in section 201(n)(2) of the Clean Water Act, enacted as a part of the Municipal Wastewater Treatment Construction Grant Amendments of 1981 (P.L. 97-117). This report is also presented as an addendum to the 1982 Needs Survey submitted to Congress on December 31, 1982. The 1982 Needs Survey considered all categories of need for construction of publicly-owned wastewater treatment facilities including all Category V (CSO) needs on a State-by-State basis. This addendum, extracted entirely from the 1982 Needs Survey data-of-record, presents a list of combined sewer facilities discharging to or affecting the tidally-influenced coastal waters of bays and estuaries and their estimated CSO control costs. The list is based on a careful map inspection and a review of State water quality standards and other available Needs Survey documentation. (Lantz-PTT)
W86-05797

DO EFFLUENT CHARGES (ALWAYS) REDUCE ENVIRONMENTAL DAMAGES,

Technische Univ. Berlin (Germany, F.R.). Wirtschaftswissenschaftliche Dokumentation.
A. Endres.
Available from the National Technical Information Service, Springfield, VA. 22161, as N83-18094, Price codes: A02 in paper copy, A01 in microfiche. Discussion paper No. 70, 1982. 16 p, 1 fig, 5 ref.

Descriptors: *Cost analysis, *Effluent charges, *Environmental effects, Water pollution control, Water pollution prevention, Environmental quality, Costs, Industrial wastes.

It seems to be common place in economics that in a perfectly competitive equilibrium, the levels of environmental damages are too high. Effluent charges are widely discussed in the literature as a corrective means. It is thought that the higher the effluent charge, the more restrictive are the environmental quality standards met. In a comparative static model, the long run adjustment of a perfectly competitive polluting firm to a change in the effluent charge rate is analyzed; the firm is assumed to have a flexible abatement technology. It turns out that the firm may in fact increase pollution when the charge rate is increased indicating that increasing charges may actually create an increase of environmental damages (not effluents) caused by the industry to which the considered firm belongs. The consequences of these findings for effluent charge policies are discussed. (Lantz-PTT)
W86-05798

ON-LINE LIQUID-EFFLUENT MONITORING OF SEWAGE AT LAWRENCE LIVERMORE NATIONAL LABORATORY,

Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5D.
W86-05799

EFFECTS OF FLOODING AND SEDIMENTATION ON GERMINATION AND SURVIVAL OF LUDWIGIA LEPTOCARPA (NUTT.) HARA,

Georgia Univ., Athens.
C. A. McCaffrey.
Available from the National Technical Information Service, Springfield, VA. 22161, as DE83-003001, Price codes: A04 in paper copy, A02 in microfiche. Report No. DOE/NBM--1048, 1982. A Thesis Submitted to the Graduate Faculty of the University of Georgia in Partial Fulfillment of the Degree Master of Science. 67 p, 5 fig, 3 tab, 112 ref.

Descriptors: *Flooding, *Sedimentation, *Germination, *Ludwigia leptocarpa, Plant growth, Silt, Root development, Wetlands, Savannah River Plant, Temperature effects, Thermal pollution.

Experimental treatments of flooding and sedimentation resulted in differences in survivorship of Ludwigia leptocarpa (Nutt.) Hara at four growth stages: newly germinated, juvenile, pre-reproductive and reproductive. Shallow (2.5 cm) flooding with or without sediment addition, had no significant impact on survivorship (99-100%) at any stage. Newly germinated plants had 97% survivorship with deep (13.3 cm) flooding as did controls; however, deep flooding plus sedimentation significantly lowered survival (68%). Reproductive plants had emergent leaves in all flood sediment treatments and had 99-100% survival. Pre-reproductive and juvenile plants started the deep flooding experiment with all leaves submerged and had significantly lower survivorship (91-83% respectively) under deep flooding. With flooding plus sedimentation, survivorship was further reduced (55% and 69%, respectively). Sedimentation and fluctuations in water levels and temperatures associated with unpredictable operation schedules of the Savannah River Plant nuclear production reactors maintain a perturbed and stressed wetland environment. Following reactor shut-down (dewatering), some of the species that were common on substrate with 0-6.5 cm of water during reactor operation germinated from recently dispersed propagules of those in the seed bank in areas that had previously been submerged by as much as 13.5 cm of heated (43 C) effluent. The distribution of this species is primarily influenced by the dispersal of copious, floating seeds to moist or shallowly flooded sites. Seeds of other species common in such thermally disturbed wetlands remain viable under conditions of high water temperatures, submergence and shifting substrate and show rapid germination upon dewatering. (Lantz-PTT)
W86-05804

SAN FRANCISCO'S WASTEWATER TREATMENT PROGRAM NEEDS REEXAMINATION AND BETTER MANAGEMENT.

General Accounting Office, Washington, DC. Mission Analysis and Systems and Acquisition Div.
For primary bibliographic entry see Field 5D.
W86-05807

EFFECT OF PHOSPHORUS LIMITATION DECREE IN DETERGENTS ON THE PHOSPHORUS LOAD IN MUNICIPAL WASTEWATER- COMPARISON OF CALCULATED AND MEASURED DATA,

Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
B. Doell, B. Gutekunst, and R. Klute.
Zeitschrift fuer Wasser- und Abwasserforschung

ZWABAQ, Vol. 18, No. 4, p 182-186, August 1985. 2 fig, 6 tab, 12 ref.

Descriptors: *Phosphorus, *Water pollution control, *Detergents, *Wastewater, West Germany, Phosphorus removal, Legislation, Water pollution prevention.

According to the 1975 phosphate limitation decree, the phosphorus content of detergents in West Germany had to be reduced by approximately 50%. The resulting reduction of the phosphorus load in municipal wastewater was calculated for four selected regions of different sizes and properties having a total area of 922 sq km. The computed data are compared with results from wastewater investigations, which have been performed since 1980 on behalf of the W. German Federal Environmental Agency. The predicted reduction of phosphorus load which amounts to >16% in the four regions is at least obtained and in some cases considerably exceeded. In total, the phosphorus load reaching the sewage works is decreased by 220 t per year. (Master-PTT)
W86-05820

SPATIAL AND TEMPORAL CHANGES OF NITRIFYING BACTERIAL POPULATIONS IN FISH PONDS OF DIFFERING MANAGEMENT PRACTICES,

Kalyani Univ. (India). Dept. of Zoology.
B. B. Jana, and S. K. Roy.
Journal of Applied Bacteriology JABAA4, Vol. 59, No. 2, p 195-204, August 1985. 6 fig, 2 tab, 19 ref.

Descriptors: *Nitrifying bacteria, *Seasonal variation, Fish ponds, Ammonia oxidizers, Fish farming, Hydrogen ion concentration, Dissolved oxygen, Phosphates, Nitrogen, Temperature effects, Model studies, Spatial distribution, Temporal distribution.

Different management practices and population densities of nitrifying bacteria can influence the concentration of nitrogen compounds, particularly ammonia. In three types of fish farming (polyculture, monoculture, and traditional), density differences of ammonia oxidizers occurred and were attributed to their nutrient status. Use of sine and cosine model is on seasonal data of ammonia oxidizers showed a sharp peak in winter suggesting that cold temperatures were conducive to the development of nitrifiers. Correlation studies showed that seasonal changes of ammonia oxidizers in the fish ponds were dependent upon pH, concentrations of nitrogen, phosphate, dissolved oxygen, organic matter, and the ratio of C to N. (Adams-PTT)
W86-05833

SIMULATION OF TWO-FLUID RESPONSE IN VICINITY OF RECOVERY WELLS,

Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-05857

ENVIRONMENTAL LAW--THE ROLE OF FDF VARIANCES IN IMPLEMENTING THE CLEAN WATER ACT'S TOXIC POLLUTANT DISCHARGE PROVISIONS. CHEMICAL MANUFACTURERS ASSOCIATION V. NATURAL RESOURCES DEFENSE COUNCIL, INC., 105 S. CT. 1102 (1985),

For primary bibliographic entry see Field 6E.
W86-05861

ECONOMICAL AND EFFECTIVE MEASURES FOR LAKE PROTECTION AND MANAGEMENT,

Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 4D.
W86-05880

GEOCHEMICAL CONTROL OF (H+) IN LAKES RECEIVING ACIDIC DEPOSITION,

Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 2H.
W86-05903

SOME ANALYTICAL SOLUTIONS FOR SEAWATER INTRUSION CONTROL WITH RECHARGE WELLS,

Canterbury Univ., Christchurch (New Zealand). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W86-05987

TRANSBOUNDARY TOXIC POLLUTION AND THE DRAINAGE BASIN CONCEPT,

Fordham Univ., Bronx, NY. School of Law.
L. A. Teclaff, and E. Teclaff.
Natural Resources Journal, Vol. 25, No. 3, p 589-612, July 1985. 74 ref.

Descriptors: *Legislation, *Great Lakes, Rhine River, *Water pollution sources, *Catchment areas, *Groundwater pollution, *International law, Legal aspects, River basins, Treaties.

Many upper riparians in international drainage basins continue to dispose of their municipal, industrial, and agricultural wastes without regard to the quality of shared surface and groundwaters and without regard to treaty obligations or precepts of international law. There are several reasons for this. International river entities possess no power to make binding and enforcable decisions. There is a lack of specific and comprehensive multinational pollution treaties. In some treaties the extent of protecting water quality can be ascertained only construing together separate references to frontier waters, water economy, water quality, groundwater, and pollution. The European Economic Community adopted a directive which is binding upon its members and which brought basin-wide control to toxic pollution somewhat nearer. The first instrument for pollution prevention and control was the 1972 Great Lakes Water Quality Agreement. The importance of toxic pollution was reflected in the 1978 Great Lakes Water Quality Agreement, the goal of which is to restore and enhance water quality in the Great Lakes Basin Ecosystem. There is probably not a jurisdiction anywhere with adequate data for the assessment of toxic pollution within its borders. The greatest obstacle to research and surveillance programs is lack of funds. Institutional means of public input to the decision making process are not lacking, but their effectiveness is largely determined by the mandate and organization of entities involved. The role of the public in providing information useful for toxic pollution control is a vital one. The river basin appears to be the best areal unit for the control of transboundary toxic pollution, but because all pollution is interrelated, the jurisidiction of the basin commission should be able to reach outside the basin. (Main-PTT)
W86-06006

POLICY RELEVANT INFORMATION AND PUBLIC ATTITUDES: IS PUBLIC IGNORANCE A BARRIER TO NONPOINT POLLUTION MANAGEMENT,

Washington State Univ., Pullman. Div. of Governmental Studies.
N. P. Lovrich, Jr., J. C. Pierce, T. Tsurutani, and T. Abe.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 229-236, April 1986. 6 tab, 16 ref.

Descriptors: *Nonpoint pollution sources, *Nonstructural alternatives, *Public policy, *Attitudes, *Spokane, Washington, Surveys, Management planning, Knowledge, Washington State 208 Water Quality Management Program, Technical information.

A study of the extent to which knowledge deficits pose a significant barrier to public support of nonpoint pollution management strategies. indicate that such barriers would obtain if all of the following conditions were present: (1) many in the public lack knowledge relevant to those strategies; (2) variations in knowledge are linked only to relatively unchanging personal attributes; and (3) individuals with more knowledge are likely to support the implementation of management strategies. Each of these conditions was subjected to empirical analysis. The findings reported here derive from a survey of citizens (524 usable questionnaires) in Spokane, Washington, the site of a major Washington State 208 Water Quality Management Program study. The results of the survey indicate that: portions of the public have enough knowledge to evaluate technically-based management strategies; sources of public knowledge are sufficiently elastic that both policy area concern and policy relevant knowledge can be elevated in the short run; and both knowledge levels and general attitudes are related to the public's specific water policy preferences. The study concludes that the apparent lack of knowledge among the public is not necessarily a significant barrier to policy implementation, and that support for implementation may be generated through both knowledge enhancement and the tapping of existing political orientations through the placement of emphasis upon the seriousness of water resource problems. (Author's abstract)
W86-06017

DESIGN AND IMPLEMENTATION OF GROUNDWATER RECOVERY SYSTEMS,

Underground Resource Management, Inc., Austin, TX.
R. L. Elton, M. Schipper, M. W. Cooper, and R. T. Kent.
Environmental Progress ENVPDI, Vol. 4, No. 3, p. 182-186, August, 1985, 5 fig.

Descriptors: *Groundwater pollution, *Water pollution control, *Legislation, Hazardous wastes, Waste disposal, Water pollution treatment.

Based on experience and raw statistics, a far greater proportion of interim status hazardous waste facilities than originally expected, have been forced into Groundwater Quality Assurance Programs. This is partly due to the rigid and often improper application of statistical procedures set forth in the interim regulatory program. Although many of these facilities may show no 'hazardous wastes or hazardous waste constituents' have entered the groundwater, the probability is high that the groundwater investigation which demonstrate the lack of such constituents, will also show such facilities to be contributing other 'non-harzardous' materials and contaminants to groundwater systems. The long-term implications of such findings are significant, both in the preparation and implementation of final hazardous waste permits, and to addressing groundwater contamination and impacts in the states where regulatory programs, other than the Resource Conservation and Recovery Act and associated state regulations, are pertinent. (David-PTT)
W86-06084

INDUSTRY REPORT,

K. McCray.
Groundwater Monitoring Review, Vol. 6, No. 1, p. 39-40, Winter 1986. 13 ref.

Descriptors: *Groundwater pollution, *Water pollution prevention, Underground storage, California, *Monitoring, Water sampling.

It is estimated that as many as 750,000 of the five-million underground storage tanks in the U.S. are leaking and contaminating ground water. The state of California is taking action against the problem. The California Hazardous Substance Storage Act requires that for every underground storage tank installed and used for hazardous substance storage, an officially approved leak monitoring system must be installed. One acceptable montioring method is the construction of a groundwater monitoring well(s), downgradient and adjacent to the underground storage tank. Also to be applied are vapor analysis within a well, for the appropriate analysis of soil borings at the time of the initial installation of the well. The diameter of the casing for monitoring wells should be just sufficient to allow the sampling tool (bailer or pump) to be lowered into the well to the desired depth. The diameter of the hole into which the casing is placed must be at least 2 inches larger to permit placement of a grout

seal around the outside of the casing. Casings and/ or holes drilled much larger than the necessary minimum can, in fact, have undesirable effects on the data. (David-PTT)
W86-06086

LOCKS WITH DEVICES TO REDUCE SALT INTRUSION,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 8A.
W86-06115

AXISYMMETRIC WITHDRAWAL AND INFLOW IN A DENSITY-STRATIFIED CONTAINER,
Australian National Univ., Canberra. Research School of Earth Sciences.
G. N. Ivey, and S. Blake.
Journal of Fluid Mechanics JFLSA7, Vol. 161, p 115-137, December 1985. 11 fig, 6 tab, 25 ref, append.

Descriptors: *Fluid mechanics, *Selective withdrawal, *Mathematical studies, *Theoretical analysis, Buoyancy, Flow pattern, Density stratification, Stratification, Density currents, Mathematical equations, Viscosity, Viscous flow, Diffusion coefficient, Water quality control, Water quality management, Reservoirs.

The axisymmetric withdrawal of fluid form a linearly stratified container is studied over the full parameter range. When only buoyancy and inertia are important, the flow in the withdrawal layer is influenced by a virtual control point and is not analogous to that observed in the two-dimensional withdrawal problem. Two other flow regimes are shown to exist in which viscous forces are important: one in which convection of species is important, and another in which diffusion of species is important. Theoretical arguments and laboratory experiments are used to support a proposed equation for the correct transition parameter, to differentiate between these possibilities. It is suggested that these results may be generalized to describe the features of several related flows: axisymmetric drawdown (or drawup) in withdrawal from a layered density structure, axisymmetric inflow into a linearly stratified environment, and the axisymmetric spreading of density currents. (Geiger-PTT)
W86-06145

WATER QUALITY SURVEYS: A STATISTICAL METHOD BASED ON DETERMINISM, QUANTILES AND THE BINOMIAL DISTRIBUTION,
Victoria Environment Protection Authority, East Melbourne (Australia).
For primary bibliographic entry see Field 7C.
W86-06159

RECOVERING FRESH WATER STORED IN SALINE LIMESTONE AQUIFERS,
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 4B.
W86-06176

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

LINEAR PROGRAMMING SCREENING MODEL FOR THE GRAND RIVER BASIN,
Ecologistics Ltd., Waterloo (Ontario).
M. Fortin, and E. A. McBean.
Canadian Journal of Civil Engineering CJCEB, Vol. 12, No. 2, p 301-306, June 1985. 2 fig, 4 ref.

Descriptors: *Management planning, *Grand River Basin, *Canada, *Linear programming screening model, Hydrologic model, Computer simulation, Water supply, Water quality, Flooding, Systems analysis.

A linear programming screening model was developed to formulate a set of comprehensive water resource management plans using individual projects to deal with problems of flooding, water quality impairment, and municipal water supply shortfalls for the Grand River Basin (Canada) study. The value of the model is described as being the forcing of a system-wide approach by analysts, identifying interdependencies, directing technical analyses, and the formulation of management plans. Information obtained from the physical river system must be integrated with socioeconomic data and project design data to create an overview of the complete river basin. The screening model is a distilled mathematical interpretation of this overview. (Rochester-PTT)
W86-05471

OPTIMAL ALLOCATION OF WATER RESOURCES.
Institute of Hydrology, Wallingford (England).
Available from the IAHS, 2000 Florida Ave., NW, Washington, DC. 20009. Price: $35.00, as IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. Edited by M. J. Lowing. 416 p.

Descriptors: *Planning, *Water demand, *Water supply, *Water management, *Water allocation, Rivers, Reservoirs, Water policy, Drought, Developing countries, Irrigation, Water quality control, Model studies.

The theme of this symposium is the optimal allocation of water resources. However, papers not directly concerning this subject have been included because of the complexity of the field and the authors' experience. The papers are listed under four main headings: (1) supporting techniques and investigative methods for primary resource development, (2) analytical methods for developing regional and national water policies, (3) analytical techniques for existing systems for operational purposes, and (4) case studies. Among the many topics covered are reservoir operation, rainfall and runoff forecasting, governmental policies, river regulation, water quality control through water quantity management, settling conflicts among users and regions, and conservation of irrigation water. (See also W86-05751 thru W86-05788) (Cassar-PTT)
W86-05750

UNCERTAINTY IN RESERVOIR OPERATION,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
For primary bibliographic entry see Field 4A.
W86-05751

GROUNDWATER STUDIES FOR LIMA, PERU,
Binnie and Partners, London (England).
For primary bibliographic entry see Field 2F.
W86-05752

PROBABILITY OF EXTREME LOW FLOWS OF VARIOUS DURATIONS,
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W86-05753

POTENTIAL WATER YIELD IN SEMIARID REGIONS,
Ministry of Water Resources and Development, Harare (Zimbabwe).
For primary bibliographic entry see Field 2A.
W86-05754

RESERVOIR STORAGE YIELD ANALYSIS FOR ARID AND SEMIARID CLIMATES,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 4A.
W86-05755

UNCERTAINTY IN RESERVOIR DESIGN - BENEFITS FROM USING SECONDARY DATA,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
For primary bibliographic entry see Field 4A.
W86-05756

MULTISITE DATA GENERATION MODEL FOR DAILY DISCHARGES,
Bochum Univ. (Germany, F.R.).
For primary bibliographic entry see Field 4A.
W86-05757

COMPETITION FOR WATER RESOURCES OF THE RIO GUAYAS, ECUADOR,
Cremer and Warner Ltd., London (England).
For primary bibliographic entry see Field 2L.
W86-05758

LONG PERIOD WEATHER RECORDS, DROUGHTS AND WATER RESOURCES,
Department of the Environment, London (England).
For primary bibliographic entry see Field 2B.
W86-05759

OVERVIEW OF THE DUTCH WATER MANAGEMENT SYSTEM,
Rijkswaterstaat, The Hague (Netherlands).
For primary bibliographic entry see Field 6E.
W86-05760

POLICY ANALYSIS OF WATER MANAGEMENT FOR THE NETHERLANDS (PAWN),
Rijkswaterstaat, The Hague (Netherlands). Data Processing Div.
M. A. Ween, and G. Baarse.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 113-122, 2 fig, 3 ref.

Descriptors: *Planning, *Water policy, *Water management, *Water allocation, Model studies, Policy Analysis of Water Management for the Netherlands, PAWN, Netherlands, Water quality control, Environmental effects, Rand Corporation, Irrigation, Agriculture, Model studies, Alternative planning, Cost-benefit analysis.

The PAWN study is a water management study at the national level, carried out by the Rand Corporation (Santa Monica, California) and the Delft Hydraulics Laboratory (Delft, The Netherlands), in cooperation with and sponsored by the Netherlands government. The study, started in 1977 and finished in 1979, considered water user categories, quantity and quality problems, and surface and groundwater. A methodology was developed to assess the multiple consequences of water management policies. This includes a general methodology for assessing impact of changes in water policy on different user groups, computer models, an organized data base, cost-benefit analyses of alternative water management schemes, and a series of impact assessments. Policy conclusions are as follows: (1) agriculture dominates all other sectors, (2) sprinkling irrigation is expected to increase, (3) the area of irrigated land will increase (4) only a few of the many canal/transport projects will be implemented, (5) water quality can be improved most efficiently on a local level, (6) lake eutrophication must be handled on an individual basis, and (7) most water management techniques have some negative effect on the environment and the population. (See also W86-05750) (Cassar-PTT)
W86-05761

APPROACH OF VARIOUS COMPETITIVE WATER USERS AND IMPACT CATEGORIES IN PAWN (POLICY ANALYSIS OF WATER MANAGEMENT FOR THE NETHERLANDS),
Waterloopkundig Lab. te Delft (Netherlands).
E. Van Beek.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 123-135, 3 fig, 4 tab, 2 ref.

Descriptors: *Planning, *Water policy, *Water use, *Water allocation, *Water management, Model studies, Policy Analysis of Water Management for the Netherlands, PAWN, The Netherlands, Water quality control, Agriculture, Navigation, Electric power, Industrial water, Drinking water, Irrigation, Powerplants.

The Distribution Model used in PAWN was applied to a study of the four major users of water in the Netherlands: agriculture, shipping, powerplants and drinking-industrial water. Examples are given to illustrate the types of results obtained from using the model. Agriculture is the dominant use. Water requirements and effects of water management changes are computed for cropping alternatives, irrigation methods, and wet-dry year combinations. The impacts of water management scenarios on shipping include water level changes in canals, sedimentation, and alterations of water quality at fresh-saline water interfaces. Water management has less effect on powerplant cooling water costs than in other user sectors. Drinking and industrial water are closely related to the scarcer groundwater supply. Three types of trade-offs among user groups are considered: between surface water users, between regions, and between groundwater users. Most trade-off possibilities exist in the surface water and groundwater categories, with agriculture dominating. (See also W86-05750) (Cassar-PTT)
W86-05762

ALLOCATION OF WATER RESOURCES IN THE EASTERN PART OF THE NETHERLANDS,

Water Service of Gelderland, Arnhem (Netherlands).
For primary bibliographic entry see Field 6B.
W86-05763

MODELLING APPROACH FOR A REGIONAL WATER MANAGEMENT STUDY IN A POLDER AREA,

Waterloopkundig Lab. te Delft (Netherlands).
G. Baarse, and G. Miedema.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 155-163, 2 fig, 1 tab, 1 ref.

Descriptors: *Planning, *Water policy, *Water use, *Water allocation, *Polder, Boezems, Water management, Netherlands, Model studies, Mathematical models, Political aspects, Saline water intrusion, Hydrology, Dikes, Locks, Water quality control, Water demand.

A modeling approach for a region below mean sea level is described. These areas are extremely flat, have saline groundwater, have high water tables, and depend on surface water for water supplied. Polders are areas of land surrounded by dikes in which water levels can be artificially maintained at the desired level. Excess water is pumped into canal-lake systems called boezems. The main problems in this region are the necessity for continuous discharge or intake, large canals (due to lack of sufficient bottom slope), and salt pollution. The boezem-polder system was studied with the ABOPOL model, which describes the flow of water and conservative pollutants through the system, given the extractions of and/or discharges from polders. The model use is illustrated with a drinking water supply study in the Rijnland water district. Here it was found that the effects of the proposed extractions were quite limited. The Delfland water board study, a proposed solution for satisfying peak demands, was devalued because peak water demands were shown to be lower than expected. (See also W86-05750) (Cassar-PTT)
W86-05764

WATER RESOURCES MANAGEMENT: FROM POLICY ANALYSIS TO POLICY FORMULATION,

Rijkswaterstaat-Deltadienst, Rijswijk (Netherlands). Data Processing Div.
For primary bibliographic entry see Field 6B.
W86-05765

FLEXIBILITY - A KEY TO THE MANAGEMENT OF RISK AND UNCERTAINTY IN WATER SUPPLY,

Espey, Huston and Associates, Inc., Austin, TX.
L. R. Beard.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 177-183.

Descriptors: *Planning, *Water management, *Risk, *Water supply, Stochastic hydrology, Reservoirs, Water shortage, Drought, Water use, Water demand, Conjunctive use, Flexibility.

Current and traditional design of water supply facilities is based on simulations of systems operation under historical hydrological conditions projected, as necessary, to future conditions. Arbitrary or subjective criteria are used relative to acceptance of shortages, provision of safety factors and risks acceptable for the various types of water use. While stochastic studies have forced re-examination of these criteria, stochastic methods have not proved to be sufficiently reliable for adoption as standard procedures. Furthermore, they do not remove the necessity of, but simply offer a more systematic approach to, the subjective selection of risk criteria. A key to the management of risk (as well as uncertainty) is flexibility of system operation. This paper examines various means of incorporating flexibility in water resource projects, based on consideration of risk and uncertainty and designed to optimize the utility of a water management system for alternative water use. (See also W86-05750) (Author's abstract)
W86-05766

INFLUENCE OF CLIMATIC VARIABILITY ON WATER RESOURCES IN JILIN PROVINCE, CHINA,

Jilin Province Inst. of Meteorological Science, Changchun (China).
For primary bibliographic entry see Field 2B.
W86-05767

ALLOCATION OF WATER FOR PUBLIC SUPPLY WITHIN SEVERN-TRENT WATER AUTHORITY,

Severn-Trent Water Authority (England).
For primary bibliographic entry see Field 6D.
W86-05768

INTEGRAL QUANTITATIVE AND QUALITATIVE PLANNING AND MANAGEMENT OF WATER RESOURCES IN THE RIVER BASINS IN THE GERBAN-KERTO-SUSILA REGION, INDONESIA,

Directorate of Water Resources Development, Djakarta (Indonesia).
For primary bibliographic entry see Field 6B.
W86-05769

PROBLEMS OF WATER RESOURCES SYSTEMS MANAGEMENT - AN INTRODUCTION,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
A. L. Velikanov.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 211-213.

Descriptors: *Planning, *Water demand, *Water management, Risk, Water supply, Systems, Engineering, Hydraulic structures.

Present-day opinions of the problem of risk and reliability as applied to water resources systems are discussed. It is shown that this problem is associated not only with the safety of hydraulic structures and adjoining areas, but also with the possibility of water supply interruption due to decision making based on probabilistic and uncertain information rather than the real situation. The simulation analysis of the behavior of water resources systems under various water abundance conditions and with the application of different management policies seems to be the most effective procedure for examining various situations and for selecting an optimal strategy of development of water resources systems. (See also W86-05750) (Author's abstract)
W86-05770

USE OF SIMULATION MODELS IN WATER RESOURCES SYSTEMS ANALYSIS,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
D. N. Korobova, and V. I. Poizner.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 215-222, 1 tab, 5 ref.

Descriptors: *Planning, *Evaluation, *Simulation analysis, *Water management, Model studies, Reservoir operation, Forecasting, Runoff, Risk, Optimization, Environmental effects, Numerical analysis, Mathematical models.

Numerical simulation has been effective in the analysis of water resources systems behavior. The following factors must be considered in forecasting: the stochastic resources vs. water demand, reservoir operation, runoff forecasting and risk, and ecological aspects. Numerical simulation techniques are compared with optimization techniques. The latter cannot be done with mathematical programming alone. However, numerical simulation combines the advantages of computers' memory and speed with human judgement. This method is illustrated in an example of hydrological forecasting. (See also W86-05750) (Cassar-PTT)
W86-05771

MULTIPURPOSE USE OF WATER RESOURCES IN IRRIGATION SYSTEMS,

State Office for Technical Development, Budapest (Hungary).
For primary bibliographic entry see Field 3F.
W86-05772

FUZZY MODELLING FOR FORECASTING DISCHARGE AND WATER LEVEL OF LARGE RIVERS,

Technische Univ., Dresden (German D.R.). Bereich Hydrologie and Meteorologie.
For primary bibliographic entry see Field 4A.
W86-05773

WATER QUALITY OBJECTIVES, DISCHARGE STANDARDS AND FUZZY LOGIC,

Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-05774

STOCHASTIC TIME SERIES ANALYSIS AND THE VILLAGE DAM MANAGEMENT PROBLEM IN SRI LANKA,

Australian National Univ., Canberra.
For primary bibliographic entry see Field 4A.
W86-05775

EVALUATION OF CONFLICTING REGIONAL WATER REQUIREMENTS: AN AUSTRIAN CASE STUDY,

Universitaet fuer Bodenkultur, Vienna (Austria). Inst. fuer Wasserwirtchaft.
H. P. Nachtnebel, L. Duckstein, and I. Bogardi.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 265-274, 3 fig, 2 tabs, 24 ref.

Descriptors: *Planning, *Water demand, *Water allocation, *Water management, Austria, Alternative planning, Model studies, Cost analysis, Dynamic programming, Competing use.

A two-step method was used to evaluate alternative long range water management schemes for the Marchfeld section of Austria. Particular concerns in this region are depletion of irrigation water, poor water quality (high BOD and nitrates), and damage to forests. The first step is a preliminary screening of alternatives using a comprehensive cost-effectiveness approach. Candidate systems are ranked by multiobjective programming techniques to select a preferred set of alternatives and their corresponding actions. In the second step a dynamic model is developed around the set of preferred alternatives. This aims to reach a compromise among conflicting objectives. (See also W86-05750) (Cassar-PTT)
W86-05776

DERIVATION AND USE OF CONTROL CURVES FOR THE REGIONAL ALLOCATION OF WATER RESOURCES,

North West Water Authority, Warrington (England).
D. Pearson, and P. D. Walsh.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 275-283, 2 fig, 1 tab, 20 ref.

Descriptors: *Planning, *Water demand, *Water allocation, *Water management, *Reservoir operation, Control curves, Drought, Regional planning, North West Water Authority, Water storage, England, Operating costs, Mathematical studies.

Control curves have been used in the United Kingdom for more than 35 years to reduce operating costs by controlling the overdrawing and pumped refill of reservoirs. The methods of derivation have changed and the development of the methods used in the North West Water Authority are described. A nondimensional approach, adapted from the nonsequential cumulative minimum flow analysis of monthly data used for calculating yield-storage curves, has been used on reservoir-only systems for which there is a paucity of data. For more complex systems monthly net additions to storage are first calculated, often from daily flow data, and then analyzed. Recent developments include the use of the methods to provide information on the reliability of the resource system when reservoir storage is low for the time of year. Developments to integrate the operation and allocation of sources regionally and for their management during droughts and other emergencies are discussed. (See also W86-05750) (Author's abstract)
W86-05777

USE OF A GENERALIZED COMPUTER PROGRAM FOR RESOURCES SYSTEMS OPTIMIZATION IN DEVELOPING COUNTRIES,

Humphreys (Howard) and Partners, Leatherhead (England).
R. W. Simpson, and G. R. Thorpe.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 285-298, 9 fig.

Descriptors: *Planning, *Systems analysis, *Water allocation, *Water management, *Optimization, *Developing countries, Water use, Simulation analysis, Jamaica, Seychelles, Indonesia, Kenya, Rivers, Water transfer, Conjunctive use, Water storage, Reservoirs, Water supply, Model studies, Computer programs, Reservoir Operation by Simulation Study, ROSS program, Competing use.

Optimization of use and just allocations between the conflicting demands of domestic, industrial and agricultural users has now become the primary theme of water resources development and management in developing countries. In seeking an economical technique for the optimization of water use with worldwide application, the authors have developed a generalized simulation approach. The approach provides for the study of large and small scale developments at a cost proportional to the magnitude of the development, by eliminating the need for expensive program development associated with the one-off model approach. The flexibility afforded by the use of a generalized model even in complex systems is illustrated by applications in Jamaica, the Seychelles, Indonesia, and Kenya involving the design, optimization, and management of water systems incorporating multiple sources, regulated river flows, inter-basin transfer and conjunctive use of storage for urban, industrial and agricultural water supply together with hydroelectric power generation. (See also W86-05750) (Author's abstract)
W86-05778

OPTIMUM ALLOCATION OF WATER RESOURCES SUBJECT TO QUALITY CONSTRAINTS,

University of the Witwatersrand, Johannesburg (South Africa).
For primary bibliographic entry see Field 5G.
W86-05779

APPLICATION OF STOCHASTIC DYNAMIC PROGRAMMING IN OPTIMIZING THE REGULATION OF HYDROPOWER RESERVOIRS,

Nanjing Hydrological Research Inst. (China).
For primary bibliographic entry see Field 4A.
W86-05780

STUDY OF A REAL TIME ADAPTIVE CLOSED-LOOP RESERVOIR CONTROL ALGORITHM,

Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W86-05781

PERFORMANCE OF A MAJOR RIVER REGULATION RESOURCE SYSTEM UNDER DESIGN CONDITIONS,

Severn-Trent Water Authority, Malvern (England).
For primary bibliographic entry see Field 4A.
W86-05783

ALLOCATION OF FRESH WATER RESOURCES OF A TIDAL ESTUARY,

Southern Water Authority, Worthing (England).
For primary bibliographic entry see Field 4A.
W86-05784

APPLICATION OF MATHEMATICAL MODELS TO PREDICTING DEMANDS, ESTIMATING THE RELIABILITY OF SUPPLY AND CONTROLLING DEMANDS,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 6D.
W86-05785

DISTRIBUTED CONJUNCTIVE USE MODEL FOR OPTIMAL CROPPING PATTERN,

Roorkee Univ. (India). School of Hydrology.
For primary bibliographic entry see Field 4B.
W86-05786

OPTIMIZATION MODELS FOR THE OPERATION OF MAJOR HYDROSYSTEMS,

California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 4A.
W86-05787

ATTEMPTS TO RECONCILE CONFLICTING DEMANDS OVER COLUMBIA RIVER OUTPUTS,

Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W86-05788

STATE OF THE ART REVIEW: THEORIES AND APPLICATIONS OF SYSTEMS ANALYSIS TECHNIQUES TO THE OPTIMAL MANAGEMENT AND OPERATION OF A RESERVOIR SYSTEM,

California Univ., Los Angeles. School of Engineering and Applied Science.
W. W. -G. Yeh.
Available from the National Technical Information Service, Springfield, VA. 22161 as PB83-169763, Price codes: A09 in paper copy, A01 in microfiche. UCLA-ENG-82-52, June 1982. 149 p, 12 fig, 2 tab, 308 ref. NSF/CEE-82091.

Descriptors: *Planning, *Systems analysis, *Reservoir operation, Dynamic programming, Linear programming, Nonlinear programming, Mathematical models, Model studies, Simulation analysis, Operations research, Computer programs, Management.

Linear, nonlinear, and dynamic programming methods and the simulation method of reservoir operations are reviewed and analyzed. The merits and limitations of each technique are assessed and recommendations for future research needs are given. The advantages of linear programming are: (1) it is able to accommodate relatively high dimensionality with comparative ease; (2) no initial policy is needed, (3) standard conditions are readily available; and (4) universal optima are obtained. Dynamic programming is shown to be capable of handling adaptive, nonlinear and stochastic problems of a reservoir system, and to specifically apply these to reservoir management functions of planning and operation. Nonlinear programming techniques, while effective, are not viable. Simulation is shown to be an effective tool for studying the operation of the complex water resources system. (Author's abstract)
W86-05790

MULTI-OBJECTIVE ANALYSIS WITH SUBJECTIVE INFORMATION,

Washington Univ., Seattle. Dept. of Civil Engineering.
R. N. Palmer, and J. R. Lund.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 111, No. 4, p 399-416, October 1985. 5 fig, 8 tab, 29 ref.

Descriptors: *Water management, *Water resources development, Objective analysis, Subjective information, Computer programs, Monitoring, Network design, Thermal powerplants.

A method for incorporating subjective information into multi-objective evaluations is based upon an eigenvalue and eigenvector analysis and structures multi-objective evaluations into a series of hierarchies in which pairwise comparisons are made. The method is demonstrated in the design of an aquatic monitoring network for a thermal power plant. Theoretical aspects of the approach are reviewed, including measures of subjective inconsistency, the sensitivity of inconsistency to pairwise comparisons, subjective scaling factors, and sensitivity of final, multi-objective weights. An interactive computer program for the application of the technique is described. The method permits the incorporation of subjective information into a formal quantitative analysis and provides measurements of the consistency of the user in developing objective weights. (Master-PTT)
W86-05811

GENERAL FORMULA FOR CALCULATING THE PROBABILITY OF FAILURE OF WATER PROJECTS AND ITS POTENTIAL APPLICATIONS,

East China Technical Univ. of Water Resources, Nanjing.
For primary bibliographic entry see Field 8A.
W86-05836

6B. Evaluation Process

EVALUATING REGIONAL DEMAND MODELS FOR ESTIMATING RECREATION-

AL USE AND ECONOMIC BENEFITS: A CASE STUDY,
Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
For primary bibliographic entry see Field 6D.
W86-05423

RISK ANALYSIS FOR RESERVOIR OPERATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 4A.
W86-05428

PROGRAMMING MODEL FOR ANALYSIS OF THE RELIABILITY, RESILIENCE, AND VULNERABILITY OF A WATER SUPPLY RESERVOIR,
Corps of Engineers, Fort Belvoir, VA. Water Resources Center.
For primary bibliographic entry see Field 4A.
W86-05429

WATER ALLOCATION: THE ROLES OF VALUE AND PRICES,
Minnesota Univ.-Duluth.
For primary bibliographic entry see Field 6C.
W86-05576

WATER - A WORLD PROBLEM,
University Coll. of Swansea (Wales).
For primary bibliographic entry see Field 6D.
W86-05587

ESTABLISHING THE OPTIMUM EXPLOITATION SOLUTIONS FOR A CONFINED AQUIFER,
Institutul de Meteorologie si Hidrologie, Bucharest (Romania).
For primary bibliographic entry see Field 4B.
W86-05693

MANAGEMENT MATRIX FOR A REGIONAL AQUIFER IN THE UNITED KINGDOM,
Binnie and Partners, London (England).
S. Puri, and K. J. Edworthy.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 877-887, 3 fig, 1 tab, 1 ref.

Descriptors: *Management matrix, *Aquifers, *England, Water resources management, Mathematical models, Groundwater recharge, Artificial recharge, Lower Greensland, Groundwater movement, Economic analysis.

Hydrogeological studies using data spanning most of a century were synthesized to provide the background for water resource management in the future. The possible management options, which are limited within a statutory framework, were considered and the results set out in the form of a matrix. The complexities involved in the setting up of a resource management strategy for a fully-developed aquifer system are presented. Complications arise when the constraints within which the managers can act, are laid out in the statutory framework. Groundwater has to be separately evaluated and the conclusions must be integrated with the overall water development strategy. This was achieved by making use of a management matrix of options and consequences. The matrix was devised to compare strategies to put them into perspective, and to help in the final selection of those options which yield the target consequences. Management strategies clearly depend upon costs and restrictions which operate on the system. The aquifer response was quantified on the basis of mathematical modelling of the physical system. The options are grouped in investment terms to consider consequences of management options. In conclusion, the policy that was recommended to the Authority is summarized in the following points: 1) Grant temporary licenses in units with unused resources, up to the annual recharge quantity; 2) no further licenses in areas overdeveloped until the practicality of artificial recharge is proven; 3) commence pilot scale artifical recharge at sites in areas with overuse of resources; 4) progressively expand artificial recharge capacity to meet demands as they arise; and 5) undertake continued studies of the aquifer flow system, in particular the detailed vertical geochemical sequence and a long-term aquifer pump test to obtain reliable specific yield of the aquifer. The method was applied to the Lower Greensand aquifer and a wide ranging management approach was derived. (See also W86-05679) (Lantz-PTT)
W86-05706

3-D DIGITAL MODEL FOR GROUNDWATER MANAGEMENT,
ARMETED/JECOR, Jeddah (Saudi Arabia).
A. R. Qazi.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 889-899, 3 fig, 6 tab, 10 ref.

Descriptors: *Groundwater management, *Model studies, *Digital models, *Aquifer systems, Confined aquifers, Groundwater depletion, Sensitivity analysis, Water rights, San Luis Valley, Colorado, Long-term planning, Short-term planning.

The groundwater resources in the complex multi-aquifer system of San Luis Valley, Colorado, 3000 sq miles in area, were analyzed. A quasi three dimensional digital model was developed to simulate the effects of groundwater withdrawals from the unconfined and confined aquifers in the valley. This model is used as a management tool to evaluate the long term effects of the use of junior ground water rights on the senior surface water rights in the valley tributaries. It can be used as a potential management tool for the unconfined or confined aquifers of the valley. It had been calibrated so that the computed and observed drawdowns were in reasonable agreement. The model is designed to be an inexpensive tool (the computer cost for an average run is twenty-five dollars), the cost of which would vary with time, length of the run and size of the problem. The model applications and sensitivity analysis indicate that the effects of inaccurate aquifer properties become negligible if the model is run for a long period of time. The model is generalized and gives overall results for the entire valley; however, it is very sensitive to small stresses. Comparison of precalibration and post-calibration model runs indicate that minor inaccuracies in aquifer characteristics do not significantly alter the computations for long term stream depletions due to pumping. (See also W86-05679) (Lantz-PTT)
W86-05707

USE OF MATHEMATICAL PROGRAMMING IN THE MANAGEMENT AND DEVELOPMENT OF ISRAEL'S WATER RESOURCES,
Tahal Consulting Engineers Ltd., Tel-Aviv (Israel).
J. Schwarz.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 917-929, 1 fig, 2 tab, 2 ref.

Descriptors: *Mathematical studies, *Water management, *Mathematical models, *Groundwater depletion, *Israel, Groundwater potential, Groundwater recharge, Groundwater availability, Groundwater management, Dynamic programming, Linear programming, Water allocation, Groundwater storage.

The water resources of Israel are managed by a national water authority, which faces problems of water scarcity and large scale transportation, storage and regulation requirements. The formulation of management policies is aided by a hierarchical set of mathematical models applying simulation, Dynamic Programming and Linear Programming methods. One of the major models is a multi-period, multi-state, multi-region, multi-season and multi-sector Linear Programming model which is used for formulating long-term capacity expansion policies interlinked with short-term allocation, transportation and storage management policies. The application of the model for policy screening, for project evaluation, and for feedback with other models is facilitated by a Matrix Generator and Report Writer which have been developed for general purpose water resources planning. (See also W86-05670) (Author's abstract)
W86-05709

IMPLICATIONS OF THE USE OF REGIONAL GROUNDWATER MODELS: A CASE STUDY,
Groundwater Development Consultants, Cambridge (England).
J. J. Van Wonderen, and R. C. Sage.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 949-958, 2 fig, 2 ref.

Descriptors: *Groundwater potential, *Model studies, *Case studies, *Computer models, Groundwater depletion, Competing use, Groundwater recharge, Bangladesh, Aquifers, Groundwater movement, Single-cell models.

A modelling study was undertaken on behalf of the Government of Bangladesh. The prime objective of the study was to set up, construct, calibrate and run a digital computer groundwater model of the whole geographical area of north-west Bangladesh. The main function of the models as to predict initial estimates of the relative numbers and distribution of well types with the available recharge, varying cropping patterns and development limitation criteria. Construction of the model involved a detailed assessment of the aquifer flow mechanisms and simulation of the water balance; it highlighted deficiencies in the data base and gave guidelines for the acquisition of more relevant information. To provide an accurate simulation, a multi-disciplinary team was required in order to assess all the relevant criteria, and present them in a suitable format. The model focused ideas on the system and the results gave a good indication of the development potential, but cannot be extrapolated for detailed planning. Single cell models were successfully used, and the model was operated by non-technical personnel. (See also W86-05679) (Lantz-PTT)
W86-05712

OPTIMAL ALLOCATION OF WATER RESOURCES.
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 6A.
W86-05750

POLICY ANALYSIS OF WATER MANAGEMENT FOR THE NETHERLANDS (PAWN),
Rijkswaterstaat, The Hague (Netherlands). Data Processing Div.
For primary bibliographic entry see Field 6A.
W86-05761

ALLOCATION OF WATER RESOURCES IN THE EASTERN PART OF THE NETHERLANDS,
Water Service of Gelderland, Arnhem (Netherlands).
E. Romijn, and M. Tamminga.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 137-153, 9 fig, 5 tab, 11 ref.

Descriptors: *Planning, *Water policy, *Water use, *Water allocation, *Water management, Netherlands, Groundwater management, Model studies, Mathematical models, Political aspects.

Water management alternatives for eastern Gelderland and Drenthe provinces, The Netherlands, were studied. These are in the higher portion of

the country. The Gelderland study produced a ranking of management plans, weighted according to goals decided by politicians. The Drenthe study produced score maps for agriculture, landscape, and ecology, which can be manipulated and weighted according to priorities. Several water management plans were evaluated using mathematical models. The major problem lies in cooperation between the scientists and the politician-decision makers. In addition, information on ecological effects of the water management policies is insufficient. (See also W86-05750) (Cassar-PTT)
W86-05763

WATER RESOURCES MANAGEMENT: FROM POLICY ANALYSIS TO POLICY FORMULATION,

Rijkswaterstaat-Deltadienst, Rijswijk (Netherlands). Data Processing Div.
M. A. Veen, G. Baarse, and E. Van Beek.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 165-175, 7 ref.

Descriptors: *Planning, *Water policy, *Water management, *Water use, Netherlands, Model studies, Decision making.

Recent developments in the Netherlands have created a need for integrated water management policies, i.e., policies that result from well balanced and integrated planning and decision making process, taking into account all relevant users and interests and their interrelations. Given the complexity of the policy area and the policy making process, policy analysis plays an important role in drafting these policies. In the recent past, three important policy studies were carried out in the Netherlands: one study at the national level and two provincial studies. Indicated here, are how these studies have contributed to the policy making process. From the experience obtained through the studies, a number of lessons were drawn with respect to organization and conduct of policy analyses in the water management area. These lessons relate to the reliability of the model results, the appropriateness of these results, the acceptance of the policy conclusions and the continuity in the availability of the resources and the models. After an overview of these lessons, the paper sketches how, in a few current developments, these lessons are brought into practice. (See also W86-05750) (Author's abstract)
W86-05765

FLEXIBILITY - A KEY TO THE MANAGEMENT OF RISK AND UNCERTAINTY IN WATER SUPPLY,

Espey, Huston and Associates, Inc., Austin, TX.
For primary bibliographic entry see Field 6A.
W86-05766

INTEGRAL QUANTITATIVE AND QUALITATIVE PLANNING AND MANAGEMENT OF WATER RESOURCES IN THE RIVER BASINS IN THE GERBAN-KERTO-SUSILA REGION, INDONESIA,

Directorate of Water Resources Development, Djakarta (Indonesia).
M. Notodihardjo, and F. C. Zuidema.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 203-209, 2 fig, 1 ref.

Descriptors: *Planning, *Water demand, *Water allocation, *Water management, Surabay, Indonesia, Rivers, Urban hydrology, Hydrology, Irrigation, Water conservation, Flood control, Water pollution, Competing use.

The rapid urban development around Surabay, Indonesia, necessitates a comprehensive plan for optimal utilization of water resources. The framework of a future study will deal with hydrology and hydrometry, domestic and industrial water needs, street flushing water, irrigation water, water conservation measures, flood protection, sanitary engineering, water resources planning and management, and training of engineers and technicians. Some of the problems faced by planners in this city are drinking water intakes located in polluted water, clashes between rural and city water users, periodic flooding, solid waste disposal in rivers and streets. (See also W86-05750) (Cassar-PTT)
W86-05769

PROBLEMS OF WATER RESOURCES SYSTEMS MANAGEMENT - AN INTRODUCTION,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 6A.
W86-05770

USE OF SIMULATION MODELS IN WATER RESOURCES SYSTEMS ANALYSIS,

Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 6A.
W86-05771

EVALUATION OF CONFLICTING REGIONAL WATER REQUIREMENTS: AN AUSTRIAN CASE STUDY,

Universitaet fuer Bodenkultur, Vienna (Austria). Inst. fuer Wasserwirtchaft.
For primary bibliographic entry see Field 6A.
W86-05776

USE OF A GENERALIZED COMPUTER PROGRAM FOR RESOURCES SYSTEMS OPTIMIZATION IN DEVELOPING COUNTRIES,

Humphreys (Howard) and Partners, Leatherhead (England).
For primary bibliographic entry see Field 6A.
W86-05778

WATER RESOURCE PLANNING FOR MAXIMUM BENEFIT,

Denver Water Dept., CO.
W. H. Miller.
American Water Works Association Journal JAWWA5, Vol. 77, No. 9, p 44-47, September 1985.

Descriptors: *Planning, *Water resources development, Recreation, Water use, Instream flow, Surface water availability, Watershed management, Judicial decisions, Public access, Public opinion.

Water utilities that depend on surface supplies face increasing public pressure to maintain in-stream flows and to open reservoirs for recreational uses. Severely restricted access to watersheds in the interest of maintaining water quality is increasingly difficult, especially in the water-short West, in view of settlements of suits involving new development of water resources. An awareness of public concerns can result in planning solutions that are acceptable to all potential users. (Author's Abstract)
W86-05866

LEAST-COST PLANNING OF IRRIGATION SYSTEMS,

Auburn Univ., AL. Dept. of Agricultural Engineering.
K. H. Yoo, and J. R. Busch.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 111, No. 4, p 352-368, December 1985. 6 fig, 8 tab, 10 ref. OWRT Project B-041-IDA.

Descriptors: *Irrigation design, *Planning, *Cost-benefit analysis, Model studies, Rehabilitation, Irrigation, Economic aspects, Mathematical analysis, Water use, Water rates, Idaho.

A mixed-integer programming model was used to obtain least-cost system rehabilitation plans for a 6,900-ha irrigation project in southeastern Idaho. Three types of gravity conveyance system components (existing unlined canal, concrete lined canal, and gravity pipe) were considered, along with five types of irrigation application systems (two gravity and three sprinkler application systems). The mixed-integer programming model that complied with the constraints specified was flexible and effective. The specified constraints used in this study are water charges and water and land availabilities. The quantitative effects of different constraints were easily evaluated. The same modeling procedure can also be used in developing scenarios of alternative system configurations for a new irrigation project development for least-cost system planning. The model gives descriptive scenarios that can assist planners, irrigators, and other interested parties in making multiple-objective planning decisions for developing or rehabilitating irrigation projects. (Authors' Abstract)
W86-05919

STOCHASTIC MODELING OF IRRIGATION REQUIREMENTS,

Central Soil Salinity Research Inst., Karnal (India).
For primary bibliographic entry see Field 3F.
W86-05928

POLICY RELEVANT INFORMATION AND PUBLIC ATTITUDES: IS PUBLIC IGNORANCE A BARRIER TO NONPOINT POLLUTION MANAGEMENT,

Washington State Univ., Pullman. Div. of Governmental Studies.
For primary bibliographic entry see Field 5G.
W86-06017

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WASTEWATER TREATMENT COSTS AND OUTLAYS IN ORGANIC PETROCHEMICALS: STANDARDS VERSUS TAXES WITH METHODOLOGY SUGGESTIONS FOR MARGINAL COST PRICING AND ANALYSIS,

Houston Univ., TX.
For primary bibliographic entry see Field 5D.
W86-05426

WATER ALLOCATION: THE ROLES OF VALUE AND PRICES,

Minnesota Univ.-Duluth.
C. L. Anderson, and J. M. Peterson.
Journal of Environmental Systems, Vol. 15, No. 1, p 71-76, 1985-86. 1 tab, 5 ref.

Descriptors: *Economics, *Pricing, *Rationing, *Allocation, Recreational uses, Opportunity costs, Policy making, United States.

The demands for water with reasonable quality have surpassed available supplies in many regions of The United States. This fact likely will lead to major changes in state and national water policy as more effective allocation of the available supplies becomes necessary. This article discusses some of the basic economic principles that may serve as guidelines for allocation. This distinction between the value of water and the appropriate price for it is emphasized in the discussion. Topics include: quotas or appropriation rights, establishment of a price for water, opportunity costs, and cases (such as recreational use) where a price rationing scheme may not be possible or appropriate. (Rochester-PTT)
W86-05576

MONETARY VALUATION OF TIMBER, FORAGE, AND WATER YIELDS FROM PUBLIC FOREST LANDS,

Rocky Mountain Forest and Range Experiment Station, Tempe, AZ.
T. C. Brown.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-179929, Price codes: A03 in paper copy, A01 in microfiche. USDA Forest Service General Technical Report RM-95, October 1982. 26 p, 10 fig, 4 tab, 44 ref.

Descriptors: *Prices, *Economic aspects, *Forests, *Public lands, Arizona, Agriculture, Irrigation, Hydroelectric power, Electric power, Powerplants, Pumping, Costs, Salt River Project.

Methods for deriving monetary values for timber, forage, and water from forests are described. These methods are: (1) constant product price (direct observation of market transactions method, cost savings method, change in net income method), (2) changing product price (selling in a competitive market, selling to produce another product), (3) revenue and cost estimation, and (4) price changes over time (base year estimates, future prices). These methods are applied to evaluating forest products in public lands in central Arizona. In Arizona the water market is not competitive. Therefore, water can be given a monetary value by several means. Its value in electricity production, calculated at an oil price of $15 per barrel, varies from $3.00 to $6.00 per acre-foot, depending which of four dams it passes through. Water running through all four dams has a $21.60 per acre-foot in the Salt River Project area. The value of water also depends on the value of argicultural products grown with the added water. Various estimates of water value range from $9 to $21.60 per acre-foot, depending on the method chosen. (Cassar-PTT)
W86-05749

DO EFFLUENT CHARGES (ALWAYS) REDUCE ENVIRONMENTAL DAMAGES,

Technische Univ. Berlin (Germany, F.R.). Wirtschaftswissenschaftliche Dokumentation.
For primary bibliographic entry see Field 5G.
W86-05798

WATER: ALLOCATING A SCARCE RESOURCE,

Virginia Commonwealth Univ., Richmond. Dept. of Economics.
For primary bibliographic entry see Field 6E.
W86-05868

PRIVATE SECTOR FINANCING FOR WATER SYSTEMS,

Young (Arthur) and Co., Seattle, WA.
R. D. Doctor.
American Water Works Association Journal JAWWA5, Vol. 78, No. 2, p 47-48, February 1986.

Descriptors: *Financing, *Economic aspects, *Privatization, *Water treatment facilities, Public policy, Taxes, Public investment, Wastewater facilities, Water conveyance, Municipal water.

Tax benefits that are currently available for private investors provide the impetus for private sector financing and operation of municipal water and wastewater facilities. Tax reforms now being considered by Congress may greatly affect private investment in the public sector. However, whatever form privatization takes in the future, the concept will probably be one of increasing importance in restructuring the financing and operation of public water and wastewater utilities. The author outlines various forms of private investments in public facilities (grants, reverve bonds, privatization, true leases, and tax-exampt lease-purchase arrangements), and discusses the probable effects of tax reform on each. (Doria-PTT)
W86-05882

PRIVATE OPERATION OF U.S. WATER UTILITIES,

Operations Management International, Inc., Kingwood, TX.
M. M. Stump.
American Water Works Association Journal JAWWA5, Vol. 78, No. 2, p 49-51, February 1986.

Descriptors: *Wastewater facilities, *Municipal water, *Water conveyance, *Privatization, *Water treatment facilities, Economic aspects, Public policy, Water management.

As increasing problems associated with the operation of municipal water and wastewater facilities in the United States are encountered, private firms are beginning to offer management and operations services to public utilities on a contract basis. Many municipalities can realize cost savings and achieve more efficient operation of their water and wastewater treatment plants through contracts with private firms. Contract operation firms offer a flexible, efficient, cost-effective, alternative to assist public managers in dealing with these issues. Such firms can become important partners, with many public works departments, in discharging their responsibilities to provide an adequate and high quality water supply to the communities they serve. The market for contract operations of water and wastewater facilities may quadruple during the next five to six years. (Doria-PTT)
W86-05883

FULL-COST WATER PRICING,

Energy Systems Research Group, Inc., Boston, MA.
J. Goldstein.
American Water Works Association Journal JAWWA5, Vol. 78, No. 2, p 52-61, February 1986. 3 fig, 8 ref.

Descriptors: *Pricing, *Water costs, *Municipal water, Economic aspects, Accounting, Boston, Massachusetts, Monetary returns, Water rates, Metropolitan water management, Water conveyance.

Many municipal water systems have traditionally priced water at far less than the cost of service, thereby requiring subsidies from general funds. Conversely, some water revenues have been diverted to meet other expenses of the city. The author cites the benefits of separate accounting for water revenues and expenses and full-cost pricing, drawing on the situation in Massachusetts. Increased efficiency and ultimate economies can be realized from the allocation of funds to undertake rehabilitation and maintenance programs. Methods of structuring rates (declining block rate, flat or uniform rate, increasing block rate, seasonal or peak rates, rate for unmetered service, and rates for new users), and obstacles to implement full-cost rates (lack of metering, historical underpricing, accounting systems, nature of the rate-settling process, institutional structure, establishing enterprise fund accounting, calculating the full cost of service, valuation of fixed assets and determination of depreciation, increased use of meters, and public education), are reviewed, and Boston's recent restructuring of water and sewer services is given as an example of improvements made possible by full-cost pricing. (Doria-PTT)
W86-05884

ECONOMIC EVALUATION OF ON-FARM WATER MANAGEMENT PROJECTS,

Colorado State Univ., Fort Collins. International School for Agricultural and Resource Development.
R. K. Sampath, E. W. Sparling, R. A. Young, and K. C. Nobe.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 191-204, April 1986. 3 fig, 2 tab, 29 ref.

Descriptors: *Economic impact, *On-farm water management, *Rate of return, *Developing countries, *Production function approach, *Markets, *Farms, Social aspects, Investment, Economic aspects, Mathematical analysis.

Private profitability calculations of on-farm water management (OFWM) activities have received attention from economists and decision makers in developing countries and in donor agencies who wish to know the impacts of their investments in OFWM on farmers' income and welfare. The primary objective of the present work was to develop consistent procedures for evaluating the impacts of OFWM investments on farmers' income and resource use. This paper examines the critical relationship between the market price of the agricultural output and production function parameters that are affected by OFWM investments. Procedures and mathematical equations are presented for computing the ex ante and ex post rates of return from OFWM investments with the help of the production function approach. Results are derived pertaining to the impacts on output, inputs use, and profit levels associated with the introduction of OFWM activity under different output-price and technological regimes. (Rochester-PTT)
W86-06013

EFFICIENCY OF WATER PRICING: A RATE OF RETURN ANALYSIS FOR MUNICIPAL WATER DEPARTMENTS,

California Univ., Santa Barbara. Dept. of Economics.
L. J. Mercer, and W. D. Morgan.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 289-295, April 1986. 4 tab, 6 ref.

Descriptors: * Rate of return, *Municipal water, *Economic efficiency, *Pricing, California, Opportunity cost, Capital investment, Surveys.

The rate of return on invested capital can be used as a guide to resource allocation by municipal water departments (MWDs) in the same way it is used in the private sector. To achieve economic efficiency, the target rate of return for MWDs should be the market rate of return as an approximation to the opportunity cost of capital. The actual internal rate of return for a sample of 30 California MWDs for the period 1970-82 was calculated for the present study. The operating internal rate of return varied across the sample MWDs from less than 2% to 14%. If 10% is taken as the opportunity cost of capital, 25 of the 30 MWDs were inefficient, i.e., earned less than 10%. Half the sample earned less than 5%. An examination of potential causes of low rates of return showed that low average water prices were the primary reason for low rates of return. For efficient operation, MWDs should set a target rate of return equal to the opportunity cost of capital and adjust water prices so as to achieve the target. (Author's abstract)
W86-06024

IS OZONE THE SOLUTION TO YOUR WATER TREATMENT PROBLEMS,

Buck, Siefert and Jost, Inc., Paramus, NJ.
For primary bibliographic entry see Field 5F.
W86-06047

APPLICATION OF EXTREME VALUE THEORY TO FLOOD DAMAGE,

Montreal Univ. (Quebec). Dept. of Economics.
P. Ouellette, N. El-Jabi, and J. Rousselle.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 111, No. 4, p467-477, October 1985, 3 fig, 2 tab, 13 ref.

Descriptors: *Extreme value theory, *Flood damage, Flood plains, Flood control structures, Hydroeconomic model, Richelieu River, Probabilistic model, Civil engineering, Economics.

Flood plain management requires assessment of the costs and benefits of all projects under consideration. The benefits translate mainly into flood damage reduction. This study presents a methodology for estimating flood damage prior to implementation of flood control structures. In this two-stage methodology, a hydroeconomic model for flood damage estimation is first developed, and a flood damage distribution function is then derived from the theory of extreme values in stochastic processes. The distribution function produces an estimation of actualized damages. The Richelieu River basin was selected for a numerical application because of its combined rural and urban characteristics and the fairly extensive sum of knowledge on the basin supplied by previous studies. (Author's abstract)
W86-06117

6D. Water Demand

EVALUATING REGIONAL DEMAND MODELS FOR ESTIMATING RECREATIONAL USE AND ECONOMIC BENEFITS: A CASE STUDY,

Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
J. B. Loomis.
Water Resources Research WRERAO, Vol. 22, No. 4, p 431-438, April, 1986. 3 tab, 38 ref.

Descriptors: *Cost-benefit analysis, *Recreation, *Model studies, *Benefits, Economic aspects, Regional analysis, Travel, Idaho, Fishing.

The U.S. Water Resources Council has twice recommended that regional or multi-site recreation economic models be relied on in place of single site models. This recommendation is evaluated by developing the advantages and disadvantages different types and sizes of regional demand models relative to water resources planning issues needing to be addressed in benefit cost analyses. The accuracy of use and benefit estimates of two different sized regional travel cost method demand models is compared with benefit estimates from single site travel cost and contingent value method estimates. The results indicate that regional or large site models in answering simple resource issues such as benefits of an existing site. For planning issues dealing with evaluation of the benefits of building a new recreation site or improving quality at an existing site, the regional approach is desirable, however. (Author's Abstract)
W86-05423

INNOVATIVE APPROACHES TO WATER ALLOCATION: THE POTENTIAL FOR WATER MARKETS,

Colorado Univ. at Boulder.
For primary bibliographic entry see Field 6E.
W86-05424

WATER – A WORLD PROBLEM,

University Coll. of Swansea (Wales).
W. G. V. Balchin.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 3, p 141-148, July 1985. 1 fig, 11 ref.

Descriptors: *Hydrologic cycle, *Water use, *World water problems, Domestic use, Agricultural use, Industrial use, Power production, Waste removal, Transportation, Recreation, Water demand, Water supply, Future planning, Public awareness.

After outlining the main categories where water is used by man (domestic, agricultural, industrial, power production, waste removal, transportation, and recreation), the author shows the relationship with the hydrologic cycle before considering the statistics of the world water problem. The nature of the future demand for water in respect to both quantity and quality follows, with an indication of recent developments and possible future improvements in water supply by manipulation of the hydrologic cycle. The importance of greater awareness of the vital part water plays in all organized societies is stressed. (Author's abstract)
W86-05587

WATER INTO THE 1990'S: THE PROBLEMS OF THE DESERT BIOME,

Birkbeck Coll., London (England). Dept. of Zoology.
For primary bibliographic entry see Field 6G.
W86-05588

GROUND WATER IN WATER RESOURCES PLANNING.

United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
For primary bibliographic entry see Field 4B.
W86-05679

MULTIPLE DEMAND AND CONFLICTS,

Wessex Water Authority, Bristol (England).
E. R. Price.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 605-617, 1 ref.

Descriptors: *Water demand, *Groundwater depletion, *England, *Wales, *Groundwater management, Water use, Aquifers, Water law, Competing use.

The administration of water resources in England and Wales is governed by the Water Resources Act 1963. The Regional Water Authorities have the power to enforce this Act. In order to cater to the diverse needs and to avoid the potential conflicts, the administrators of river regions use this power. To be effective they must recognize and safeguard the rights of both present and future users, but not at the expense of other interests. The paper concludes that: (1) multiple demands among groundwater users exist but conflict is most likely to arise as a result of the effects of groundwater use on other interests, (2) legislation when effectively used will assure fairness in use of groundwater and control the effects of this use on rivers, (3) the effect of any groundwater abstraction may be damaging but this can be minimized by communication between users from early stages of investigation through to full development, and (4) water in aquifers needs to be protected from a variety of land uses. Agriculture practices are changing and could bring about problems in the future. (See also W86-05679) (Lantz - PTT)
W86-05684

ANALYSIS OF USING GROUND WATERS IN DIFFERENT SECTORS OF THE ECONOMY,

Belorusskii Nauchno-Issledovatelskii Inst. Melioratsii i Vodnogo Khozyaistva, Minsk.
A. Shtakovsky.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 635-640, 7 ref.

Descriptors: *Groundwater, *USSR, *Water analysis, Groundwater potential, Industrial water, Irrigation water, Municipal water, Surface water.

Characteristics of ground water resources are specified, and their advantages are outlined as a source of water supply over surface waters. Based on the analysis of the USSR's positive experience in the use of ground and surface waters, the paper summarizes criteria applied in the justification of water-supply sources in different sectors of the economy. Ground water uses are characterized in the municipal, industrial and irrigation sectors. Emphasis is made on the importance of ground water protection from depletion and pollution. (See also W86-05679) (Author's abstract)
W86-05686

GROUNDWATER RESOURCES DEVELOPMENT AVOIDING CONFLICTS OF USAGE: EXAMPLES OF MODERN PLANNING STRATEGIES,

Ingenieurbuero Dr. Ing. G. Bjornsen, Kobenz (Germany, F.R.).
K. Zipfel.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 661-672, 7 fig, 6 ref.

Descriptors: *Groundwater potential, *Groundwater depletion, *Management planning, Model studies, Computer models, Case studies, Water resources development, Multipurpose reservoirs, Competing use.

Modern groundwater resources planning provides means to treat these resources within multiple-usage systems. In order to coordinate different uses, methods are needed which are capable of considering the complex structure of multiple-usage interests and rights. Presented problems and their solutions reveal the necessity of comprehensive planning, since groundwater usage has reached an intensive level in the Central European regions. Examples show that institutions responsible for environmental management, have most sensitively recognized the importance of the subject. Demonstrative examples of groundwater reservoirs serving multiple-purpose interests are presented, from regions in the Upper Rhine Basin, the Danube and Lech River valleys and the Loisach Valley, Germany. (See also W86-05679) (Lantz-PTT)
W86-05689

JOINT USE OF SURFACE WATER AND GROUND WATER OR LARGE AQUIFERS OF VOLCANIC ORIGIN (L'USAGE CONJOINT D'EAUX SUPERFICIELLES ET D'EAUX SOUTERRAINES DANS UN BASSIN OU L'ON A UN GRAND AQUIFERE CONSTITUE DE ROCHES VOLCANIQUES),

Catania Univ. (Italy). Ist. di Scienza della Terra.
A. Auerli.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 675-683, 2 fig, 2 tab, 2 ref.

Descriptors: *River basins, *Groundwater, *Competing use, *Sicily, *Mount Etna, Water use, Groundwater reservoirs, Reservoirs, Aquifers, Alcantara River, Volcanoes.

On the northern slope of Etna, the great volcano of Sicily, there is a River, the Alcantara, which is rich in sources supplied by a large waterbearing stratum of volcanic origin. This basin is interesting because it is the richest of Sicily. The volume of surface waters is valued at 7,500,000 cu m, and the annual mean volume of subterranean waters which can be exploited on average is valued at 1,050,000 cu m. The joint exploitation program of available resources has made it necessary to design four surface basins and an underground reservoir. To operate this reservoir plans have been made to construct a diaphragm wall with a surface of 50.000 sq m and a height of about 150 m. At the bottom of this watertight membrane a drainage gallery capable of a maximum flow of 5 cu m/s will be built. (See also W86-05679) (Author's abstract)
W86-05690

MANAGING THE INTEGRATION OF GROUNDWATER AND SURFACE WATER RESOURCES: A CASE STUDY OF SUPPLYING POTABLE WATER TO THE LILLE METROPOLITAN AREA (GESTION INTEGREE DES RESSOURCES EN EAU SOUTERRAINE ET SUPERFICIELLE: LE CASE DE L'ALIMENTATION EN EAU POTABLE DE LA METROPOLE LILLOISE),

Bureau de Recherches Geologiques et Minieres, Lille (France). Service Geologique Regional Nord Pas-de-Calais.
J. Becklynck, M. Besbes, P. Combes, P. Hubert, and G. Marsily.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 685-695, 6 fig, 7 ref.

Descriptors: *Surface-groundwater relations, *Water resources development, *Drinking water, *Potable water, *Lille, *France, Roubaix, Tourcoing, Dynamic programming, Economic aspects, Groundwater potential, Aquifers, Groundwater recharge, Lys River.

Various sources of surface and ground water are used to supply the urban area of Lille, Roubaix, and Tourcoing. Using a stochastic dynamic programming approach, it was possible to determine how the whole system should be operated, in order to minimize the cost of the water delivered to the users. This plan takes into account the technical constraints attached to each of the resources, and also the annual variability of the recharge to the aquifers and of the flow in the Lys river. (See also W86-05679) (Author's abstract)
W86-05691

NUMERICAL MODEL FOR OPTIMAL GROUNDWATER MANAGEMENT,

Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Wasserbau.
For primary bibliographic entry see Field 4B.
W86-05692

ARTIFICIAL RECHARGE OF WATER LEVEL IN MOULLE (P OF C): AN EXAMPLE OF WATER RESOURCE MANAGEMENT(L'ALIMENTATION ARTIFICIELLE DE LA NAPPE DE MOULLE (P OF C): UN EXEMPLE DE GESTION DE LA RESSOURCE),

Societe Lyonnaise des Eaux et de l'Eclairage, Paris (France).
For primary bibliographic entry see Field 4B.
W86-05697

ECONOMETRIC SYSTEM MODEL FOR PLANNING AND MANAGEMENT OF GROUNDWATER RESOURCES,

Instituto Politecnico Nacional, Mexico City.
A. Delagado-Lopez, and W. W. -G. Yeh.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 777-786, 3 tab, 8 ref.

Descriptors: *Econometrics, *Groundwater availability, *Model studies, *Groundwater management, Groundwater depletion, Groundwater recharge, Linear models, Economic aspects, Orange County, California, Mathematical studies, Statistical analysis.

A dynamic econometric system model was developed to relate water supply sources for groundwater replenishment use, groundwater demand, groundwater conservation policies and operational issues to hydrologic, economic and demographic basin characteristics. The model is linear and relates exogenous variables to endogenous variables by a system of ten linear simultaneous equations. The coefficients of the model are estimated by a three stage least squares method. The results indicate elasticity shifts in some parts of the study period from 1950 to 1981. Results found in this study, as with most quantitative estimations, are suggestive rather than conclusive. Nevertheless, the econometric system model has the advantage of facilitating analysis of planning and management groundwater resources problems. The model has been successfully tested using data associated with the Orange County Water District, CA., over the period 1950-1981. (See also W86-05679) (Lantz - PTT)
W86-05698

MASTER PLAN FOR HYDRO POWER DEVELOPMENT,

S. Radler.
IN: Symposium on Project Design and Installation of Small Hydro Power Plants, Vienna, Austria, June 29-July 1, 1981. p 29-40, 5 fig, 2 ref.

Descriptors: *Hydroelectric plants, *Electric power production, *Water management, *Competing use, *Available water, Water demand, Water resources development, Economic aspects, Ecological effects.

A power development master plan forms the basis for the utilization of a water course or river basin for power generation. However, where utilization of the hydro potential of a stream is envisaged, allowances must at the same time be made for all the other requirements and uses connected with water resources such as drinking and industrial water, irrigation, flood control and pollution control, fisheries, and provision of recreation areas as well as protection of landscape and environment. Preparation of a master plan requires knowledge about the physical features of the area under consideration. Minimum requirements regarding topographical, geological and hydrological information should be satisfied. Development planning is governed by structural, administrative, power and finally ecological and economic aspects. Recommendations are made in this report regarding the representation of the plan on drawings. In consistent pursuit of intended purposes and objectives, master plans for hydro development should form the basis for legislative measures. (See also W86-05734) (Author's abstract)
W86-05736

APPROACH OF VARIOUS COMPETITIVE WATER USERS AND IMPACT CATEGORIES IN PAWN (POLICY ANALYSIS OF WATER MANAGEMENT FOR THE NETHERLANDS),

Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 6A.
W86-05762

MODELLING APPROACH FOR A REGIONAL WATER MANAGEMENT STUDY IN A POLDER AREA,

Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 6A.
W86-05764

INFLUENCE OF CLIMATIC VARIABILITY ON WATER RESOURCES IN JILIN PROVINCE, CHINA,

Jilin Province Inst. of Meteorological Science, Changchun (China).
For primary bibliographic entry see Field 2B.
W86-05767

ALLOCATION OF WATER FOR PUBLIC SUPPLY WITHIN SEVERN-TRENT WATER AUTHORITY,

Severn-Trent Water Authority (England).
T. Kitson.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 193-202, 2 fig, 1 tab, 1 ref.

Descriptors: *Planning, *Water demand, *Water supply, *Water management, *Water allocation, Water use, Severn-Trent Water Authority, Model studies, Computer models, Mathematical models, Costs, Operating costs, Capital costs, Drought, Simulation, Linear analysis, England, Wales.

A computer model using simulation and linear programming matches present and future water supplies and demands in the Severn-Trent Water Authority, England and Wales. Annual precipitation averages 760 mm, 2400 mm in the west to 600 mm in the central and eastern parts. Water sources, in equal proportions, are reservoirs, rivers, and groundwater. Demand forecasts are made for 25 demand centers. Standards of reliability are summarized as follows: (1) restraints in water use and bans on non-essential uses have a 1 in 10-15 chance of occurrence, lasting 2-3 months, most likely in late summer to autumn, (2) reduced prescribed river flows have a 1 in 25 chance of occurrence, lasting 6 months, most likely in late summer to spring, and (3) rota cuts and/or standpipes have not been required in the last 50 years. Allocation modeling has reduced operating costs by minimizing costs of power and chemicals and by producing information for pump scheduling. Future development plans are outlined. These include several large water supply schemes, strategic links, groundwater projects, and better service to rural areas. (Cassar-PTT)
W86-05768

MULTIPURPOSE USE OF WATER RESOURCES IN IRRIGATION SYSTEMS,

State Office for Technical Development, Budapest (Hungary).
For primary bibliographic entry see Field 3F.
W86-05772

APPLICATION OF MATHEMATICAL MODELS TO PREDICTING DEMANDS, ESTIMATING THE RELIABILITY OF SUPPLY AND CONTROLLING DEMANDS,

Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
L. Iritz, L. Kelemen, and A. Szollosi-Nagi.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 367-376, 7 fig, 10 ref.

Descriptors: *Planning, *Water demand, *Water supply, *Water management, Tisza Basin, Hungary, Model studies, Mathematical models, Forecasting, Industrial water, Water storage, Competing use, Resources management, Stochastic hydrology.

The balance between water supplies and demand will be increasingly difficult to maintain in the future. Relief of conflicts is being sought in Hungary by intensive water management research, in which mathematical models play a role of growing importance. The application of such models to comprehensive water resources management planning is presented. For forecasting water demands, multi-dimensional matrices have been developed and estimation methods standardized for the different consumers. The reliability of meeting the predicted demands have been estimated by a stochastic simulation technique. The results of modelling have disclosed a number of difficulties in meeting the demands which must be controlled in the future. The heaviest water demands in Hungary are those of industry, for which basic models have been formulated on the principle of demand control. (See also W86-05750) (Author's abstract)
W86-05785

ATTEMPTS TO RECONCILE CONFLICTING DEMANDS OVER COLUMBIA RIVER OUTPUTS,

Oregon State Univ., Corvallis. Dept. of Geography.
K. W. Muckleston.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 395-403, 1 fig, 11 ref.

Descriptors: *Planning, *Water demand, *Institutional constraints, *Rivers, Columbia River, Political aspects, Irrigation, Hydroeletric power, Powerplants, Fisheries, Fish passages, Aquatic habitats, Habitats, Salmon, International agreements, State jurisdiction, Dams, Competing use.

Three cases of conflicting demands over Columbia River outputs are considered. The first, irrigation vs. generation of hydroelelctric energy, is a relatively recent conflict and thus far no reconciliation has taken place. Institutional modifications are needed before conflict resolution can take place. The case of salmon vs. hydropower illustrates limited reconciliation, largely through increased hatcheries and improved fish passage facilities and habitat. Coordination between actors and modification of hydroelectric operating procedures are less well developed. The third case considered of issues over provision of upstream storage in one jurisdiction that provides benefits to downstream interests. Agreement to share downstream benefits was the key to U.S.-Canadian resolution of this issue. The four states in the U.S. Pacific Northwest have been unable to do this. It is concluded that the technological approach to conflict resolution is popular but needs to be balanced with institutional modifications. (See also W86-05750) (Author's abstract)
W86-05788

COMPETING USES FOR LIMITED WATER,

Denver Water Dept., CO.
G. A. Campbell.
American Water Works Association Journal JAWWA5, Vol. 77, No. 8, p 34-39, September 1985. 17 ref.

Descriptors: *Water Use, *Competing Uses, *Water rights, Priorities, Economic Aspects, Colorado, Water Supply, Legal aspects.

As needs for water increase in the growing economy of Colorado, especially in urban areas, old priority uses will have to give way to new percep-

tions of beneficial applications. The prior use doctrine, although theoretically applicable to the values of the marketplace, has practical shortcomings when senior water rights are sold for a different use. Agricultural use of water, which consumes a large share of Colorado's water entitlements at a low economic benefit, may have to be curtailed in the future in favor of more valuable uses, e.g., industrial and municipal use. Federal environmental legislation sharply discourages consumptive, economically productive uses of water in favor of nonconsumptive in-stream use. These legislative programs are certain to influence the development and expansion of water use in Colorado. (Doria-PTT)
W86-05864

CHOICES OF IRRIGATION TECHNOLOGIES IN CALIFORNIA,
California Univ., Berkeley. Dept. of Agricultural and Resource Economics.
For primary bibliographic entry see Field 3F.
W86-06116

6E. Water Law and Institutions

INNOVATIVE APPROACHES TO WATER ALLOCATION: THE POTENTIAL FOR WATER MARKETS,
Colorado Univ. at Boulder.
C. W. Howe, D. R. Schurmeier, and W. D. Shaw, Jr.
Water Resources Research WRERAO, Vol. 22, No. 4, p 439-445, April, 1986. 1 tab, 43 ref.

Descriptors: *Planning, *Water law, *Water rights, *Water allocation, *Marketing, Water demand, Water policy, Water use, Legal aspects, Economic aspects, Water transport, Interbasin transfers, Water supply, Colorado, Northern Colorado Water Conservancy District.

Advantages of marketing water over other water allocation mechanisms include flexibility, security, predictability, and fairness. However, shortcomings related to quantity and quality return flow effects exist. These can be mitigated through changes in the administrative framework of the water rights system. Effects on third-parties must be accurately and quickly identified to obtain agreement without excessive transaction costs. Good communication between potential buyers and sellers must be established where these parties are separated geographically. Methods must be found to protect public good values generated by instream flows and higher water quality. An economically efficient water allocation system would neither a priority nor a proportional rights system. A simple model is given to optimize water allocation and water quality. An efficient set of market arrangements used in northeastern Colorado are described as an example which can be easily adopted by water conservancy districts. Devices for intrastate water marketing include interstate compacts and litigation under the doctrine of equitable apportionment. (Cassar-PTT)
W86-05424

ALGORITHM FOR SURFACE/GROUNDWATER ALLOCATION UNDER APPROPRIATION DOCTRINE,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
T. H. Illangasekare, and H. J. Morel-Seytoux.
Ground Water GRWAAP, Vol. 24, No. 2, p 199-206, March-April, 1986. 1 fig, 24 ref.

Descriptors: *Water law, *Groundwater management, *Conjunctive use, *Water allocation, *Water rights, Model studies, Algorithms, South Plate River, Colorado, Irrigation, Prior appropriation, Appropriation, Legal aspects, Wells, Riverflow, Streamflow.

A stream-aquifer simulation model was developed to evaluate different conjunctive use management strategies in the South Platte River in Colorado. A component of this model simulates the allocation of surface and groundwater for agricultural use. The water law based on the doctrine of prior appropriation provides the basic framework for water allocation in the study area. The physical sequence in which the river diversions are located along the river is different from the sequence in which the water has to be allocated according to the priority of rights. An algorithm is designed to allocate the river flows computed by the physical simulation component of the model to the appropriators according to the water rights and other imposed criteria as specified by the conjunctive management scheme under study. The algorithm is demonstrated on a management problem involving the evaluation of a streamflow augmentation scheme in the study reach. The results showed that this was not the best plan of augmentation by the fact that the damages due to pumping were not fully compensated. (Cassar-PTT)
W86-05445

SEWAGE TREATMENT: WHEN THE FEDERAL GOVERNMENT PULLS THE PLUG,
Water and Wastewater Equipment Mfrs. Association, Washington, DC.
F. Summer.
The Environmental Forum, Vol. 4, No. 12, p 8-13, April 1986.

Descriptors: *Municipal constuction grants, *Financing, *Privatization, *Wastewater treatment facilities, Industrial development bonds, Regulations, Federal government, United States, Legislation, Public policy, Municipal wastewater, Construction.

The Federal Governement's municipal construction grants program is described, including its past uses, water pollution regulation compliance requirements, and the legislative and fiscal difficulties involved in continuing the program. The requirements for additional construction grant funds for many municipalities are discussed, and the various ways of meeting these needs are reviewed, including continuing federal grants, state revolving funds, and privatization (including industrial development bonds). (Rochester-PTT)
W86-05509

EGYPT SEWERAGE FIX BEGINS TO TAKE HOLD,
For primary bibliographic entry see Field 5D.
W86-05510

ACID RAIN: THE INTERNATIONAL RESPONSE,
Council on Environmental Quality, Washington, DC.
G. L. Brady, and J. C. Selle.
International Journal of Environmental Studies IJEVAW, Vol. 24, No. 3/4, p 217-230, May 1985. 3 tab, 48 ref.

Descriptors: *Acid rain, *International agreements, *Acid deposition, *Geography, *Europe, *Scandinavia, *Canada, *United States, *Policy making, Research, Atmospheric transformation, Sulfur dioxide, Nitrogen oxides, Buffering, Damage.

The international response to acid rain is discussed, including background on the technical aspects of acid rain and the international dimensions of the problem. Topics include: What is acid rain, An acidity benchmark, What are the causes of acid rain, atmospheric transformation of SO2 and NOx to acid deposition, transport of acid materials, the damages of acid rain, buffering, physical measures to reduce acid rain (sulfur and nitrogen control technologies), and global responses to acid raid (Europe, Scandinavia, Canada, and United States). Due to its geographic scale, acid deposition must be considered an international issue. On a concerted international cooperative effort can bring about a successful resolution of this issue. The international mechanisms and agreements under development or in existence provide optimistic signs for the future of acid research and control. (Rochester-PTT)
W86-05577

ROLE OF ADMINISTRATOR IN WATER CONTROL IN THE 1990'S,
Welsh Water Authority, Powys.
J. E. Jones.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 3, p 189-193, July 1985.

Descriptors: *Policy making, *Management planning, *England, *Wales, National Water Council, Water authorities, Cost analysis, History, Conservation, Environmental management.

The changes that have occurred in the last decade since the establishment of a completely new structure for the water industry in England and Wales are considered. The significance of this period of change and the challenges arising from these changes are described, including the objectives to be attained. Conservation and environmental management issues are examined, and the outlook for the future is discussed. During the period since April 1, 1974, when the National Water Council and Water Authorities began their work, there has been a shift in management objectives from sole emphasis on ensuring that the reasonable needs of the customers be met to an approach that requires that the services must be provided at reasonable cost as well. (Rochester-PTT)
W86-05592

OVERVIEW OF THE DUTCH WATER MANAGEMENT SYSTEM,
Rijkswaterstaat, The Hague (Netherlands).
K. P. Blumenthal.
IN: Optimal Allocation of Water Resources, IAHS Publication No. 135. Proceedings of a Symposium held at the First Scientific General Assembly of the IAHS at Exeter, England, July 19-30, 1982. p 103-112, 3 fig.

Descriptors: *Water law, *Institutions, *Estuaries, *Water management, *Netherlands, Polders, Saline water intrusion, Delta Project, Political aspects, Floods, Canals, Water pollution, Water policy, Dikes, Meuse River, Rhine River.

The history of the Dutch water management system is described from technical and institutional aspects. Most of the country lies in the estuarine area of three rivers. The western and northern parts lie lower than average high-tide levels; some land is as much as 6 m below mean sea level. The long history of the fight against sea and river floods is one of successes and defeats. Starting with dikes built centuries ago, a series of water projects has altered the hydrology of the area. These include creation of the fresh water Ijssel Lake in 1932, implementation of the Delta Project following the floods of 1953, building canals in the Meuse River and other waterways, and construction of polders. In general terms, the major problem is transportation of the desired quantities of water of the desired quality at the right time to the right places. Salt from the sea and from the Rhine River is the major water quality problem. Other pollutants are chemicals, organic matter, heavy metals, eutrophication, and waste heat. The early institutional organizations (most of which still exist along with central government agencies) are the dike boards, storage basin boards, and water purification boards. This decentralized structure has become more integrated in recent years. The major legislations are the Law against Pollution of Surface Waters, the Groundwater Act, and the Water Management Act. (See also W86-05750) (Cassar-PTT)
W86-05760

ENVIRONMENTAL LAW--THE ROLE OF FDF VARIANCES IN IMPLEMENTING THE CLEAN WATER ACT'S TOXIC POLLUTANT DISCHARGE PROVISIONS. CHEMICAL MANUFACTURERS ASSOCIATION V. NATURAL RESOURCES DEFENSE COUNCIL, INC., 105 S. CT. 1102 (1985),
F. L. Fisch.
Land and Water Law Review, Vol. 31, No. 1, p 79-88, 1986.

Descriptors: *Natural Resources Defense Council, *Clean Water Act, *Chemical Manufacturers Association, *Toxic pollutant discharge, *Discharge, *Pollutants, Environmental Protection Agency, Water pollution control, Legislation, Standards, Water quality standards, FDF variance.

In 1977 Congress amended the Clean Water Act by adding section 301(l), which forbids the EPA to 'modify any specific requirement of this section as it applies to any specific pollutant' on a list contained in the law. EPA issued regulations that set maximum allowable levels for the discharage of pollutants. To assure that EPA's standards would not unfairly burden an individual discharger, the standards contained a provision for a variance if the factors that EPA considered in setting the discharge levels fundamentally different from those applicable to a discharger seeking a variance. This provision is known as the fundamentally different factor (FDF) variance. The Natural Resources Defense Council challenged the provision claiming that all FDF variances violated section 301(l). The Third Circuit decided in NRDS's favor, but the Supreme Court in a five to four decision reversed the Third Circuit. The Supreme Court was wrong to uphold all EPA's unorthodox and illogical interpretations of section 301(l), but the error probably will not cause widespread environmental damage because few plants have sought and fewer have obtained the FDF variance. (Jones-PTT)
W86-05861

COMPETING USES FOR LIMITED WATER,

Denver Water Dept., CO.
For primary bibliographic entry see Field 6D.
W86-05864

WATER RIGHTS IN AN AGE OF ANXIETY,

Hawaii Univ. at Manoa, Honolulu. School of Law.
W. B. C. Chang.
American Water Works Association Journal JAWWA5, Vol. 77, No. 9, p 40-43, September 1985.

Descriptors: *Water rights, *Legal aspects, *Hawaii, Riparian rights, Public policy, Judicial decisions, Decision making, Water users.

Water law grows and changes as society changes. In post-World War II Hawaii, this evolution is particularly evident in recent judicial rulings relating to the riparian doctrine of water rights. The trend is classified into three phases: interpretation of common law based on precedents, fractionalization of common law, and policy-oriented decision making. Three recent judicial rulings are used to illustrate the three-phase concept and to illustrate that the traditional judicial model of interpreting and applying precedents is being replaced by judicial decision-making based on fairness. (Doria-PTT)
W86-05865

WATER: ALLOCATING A SCARCE RESOURCE,

Virginia Commonwealth Univ., Richmond. Dept. of Economics.
T. C. Campbell.
American Water Works Association Journal JAWWA5, Vol. 77, No. 9, p 53-56, September 1985.

Descriptors: *Resource allocation, *Water rights, Riparian rights, Priorities, Water supply, Economic aspects, Pricing.

Shortcomings of the riparian doctrine of water rights are considered as well as the prior appropriation doctrine in view of the increasing pressure on water supplies. States in the western U.S. have shown little inclination to use the market system and tend to rely on the legal system of prior appropriation. States in the East have relied on riparian rights adopted from the English system of law. The most common water allocation problems are related to requirements of municipalities and to the irrigation of farms. To solve the problem of shortages that will inevitably occur, market pricing, in lieu of costly water development projects, is advocated as a means of allocating water supplies for priority uses. (Doria-PTT)
W86-05868

PRIVATIZATION OF WATER SYSTEMS IN FRANCE,

Compagnie Generale des Eaux, Paris (France).
J.-D. Deschamps.
American Water Works Association Journal JAWWA5, Vol. 78, No. 1, p 34-40, January 1986. 3 fig, 1 tab.

Descriptors: *Privatization, *Water treatment facilities, *France, Metropolitan water management, Water management, Wastewater facilities, Water conveyance, Economic aspects.

Private companies in France, operating under the oversight of local municipal authorities, are responsible for a large share of the country's water and sewer utilities. Highly successful in providing state-of-the-art technologies for the management and treatment of water and wastewater systems, these firms now have the financial and human resources to extend their operations abroad, thus providing leadership in the privatization of public services. The operations of the largest of these companies, the Compagnie Generale des Eaux, serves 4.5 millin water users. In research activities, the Compagnie Generale des Eaux keeps bench - and pilot-scale studies to a minimum and rely on industrial-scale experiments on-site to gain several years of lead time. The private sector has developed a number of water treatment techniques including ozonation, clarifiers, and the biocarbon clarifier. (Doria-PTT)
W86-05872

ENGINEER'S VIEW OF PRIVATIZATION: THE CHANDLER EXPERIENCE,

Pirnie (Malcolm), Inc., White Plains, NY.
G. P. Westerhoff.
American Water Works Association Journal JAWWA5, Vol. 78, No. 2, p 41-46, February 1986. 1 tab.

Descriptors: *Privatization, *Wastewater treatment facilities, *Chandler, *Water management, Arizona, Municipal water, Economic aspects, Management planning, Water treatment facilities.

An increasing number of municipal agencies are giving serious consideration to privatization of their water and wastewater treatment facilities. There are many different perspectives on privatization–those of the municipal agency, the private sector, the financial advisor, the legal advisor, and the consulting engineer, with each viewing the process somewhat differently. These views must reach a common ground for privatization to be successful. Construction of the first major privatized wastewater reclamation facility at Chandler, Arizona demonstrates that the process can work, saving the city both time and money in implementing a badly needed facility. From the traditional point of view of the consulting engineer, the process utilized at Chandler has become a model for many other projects considering or moving toward privatization. The consulting engineer's role is seen as that of an independent technical advisor, or watchdog. (Doria-PTT)
W86-05881

PAYING FOR WATER,

L. Mosher.
National Journal, Vol. 18, No. 22, p 1313-1315, May 31, 1986.

Descriptors: *Water costs, *Irrigation, *Water policy, California, Westland, San Joaquin Valley, Bureau of Reclamation, Selenium, Kesterson Reservoir.

The issue in a pending lawsuit is whether a California water district is paying enough for the irrigation water and drainage services it gets from the government. How Westlands Water District vs. United States is resolved will affect not only the future of about 280 farms spread out over 650,000 acres on the west side of California's desert-like San Joaquin Valley; it could also shape the future of irrigated farming throughout the West. Westland filed its suit in 1981 after the federal government threatened to cut off its supply of irrigation water unless it agreed to pay more for the costs of removing the polluted drainage. The Interior Bureau of Reclamation Bureau contracted in 1963 to supply irrigation water to Westlands at $8.00/acre-foot through 2007. It now costs the Bureau at least $44.00/acre-foot to provide this water. Westlands supplies the subsidized water to farmers who grow crops and then apply for Agriculture Department subsidies. Westlands initiated its lawsuit five years ago after Interior Secretary James G. Watt threatened to cut off its water if it didn't agree to pay full costs for its federal water and amend its repayment agreement to cover all of the government's distribution and drainage costs. The Watt ultimatum followed years of negotiations. The problem is complicated by the discovery of the large concentrations of selenium at the Kesterson Reservoir, where the San Luis drain terminates. On March 15, 1985, Secretary Donald P. Hodel announced that the Central Valley Project would no longer provide irrigation water to Westlands' selenium-implicated 42,00 acres. However, Hodel agreed to continue to provide water if Westlands ended its selenium-tainted drainage into the Kesterson Reservoir by June 30, 1986. Judge Price has given Westlands and the Bureau of Reclamation until the end of July to come to terms or return to court. The current version would provide Westlands with the 900,000 acre-feet of water it has been getting at the 1963 rate of $8 but would charge $16 for an additional 250,000 acre-feet. (Peters-PTT)
W86-05951

EXCEPTION THAT APPROVES THE RULE: FDF VARIANCES UNDER THE CLEAN WATER ACT,

W. Funk.
Boston College Environmental Affairs Law Review, Vol. 13, No. 1, p 1-60, 1985.

Descriptors: *Pollution control, *Water pollution control, *Regulations, *Effluent limitations, *Toxicity, *Environmental protection, Supreme Court, Chemical Manufacturers Association, Water pollution, Federal Government.

In Chemical Manufacturers Association v. NRDC, the Supreme Court addressed the applicability and scope of the so-called fundamentally different factors (FDF) variance from the effluent limitations of the Clean Water Act. The Court held that the statutory prohibition against the Administrator of the Environmental Protection Agency modifying any toxic effluent limitation did not prohibit FDF variances from the generally applicable toxic effluent based upon their particular circumstances. In practical effect this can only lead to less stringent controls on toxic water pollution. In 1972, Congress enacted comprehensive amendments to the Federal Water Pollution Control Act, and thereby created the current regulatory structure addressing the problem of water pollution. Central to the new scheme was a shift of responsibility from the state to the federal government and a shift of control technique, from one focusing on receiving water quality to one focusing on technology-based effluent limitations. To determine the permissibility of an agency's interpretation of its statute, the majority in Chemical Manufacturers looks to the goals and operation of the statutory scheme to determine if they would be frustrated by the possibility of FDF variances for toxic pollutants. It is suggested that Chemical Manufacturers is not likely to have important environmental consequences, notwithstanding the fact that the Court broadened the range of limitations and standards for which an FDF variance could be granted. (Peters-PTT)
W86-05952

RISING WATER: THE NATIONAL FLOOD INSURANCE PROGRAM AND LOUISIANA,

Tulane Univ., New Orleans, LA. School of Law.
O. A. Houck.
Tulane Law Review, Vol. 60, No. 1, p 61-164,

October, 1985.

Descriptors: *Flood insurance, *Floods, *Louisiana, *Rivers, *Marshes, Louisiana bayous, Swamps, Lakes, Congress, Federal assistance, Levees.

Flooding is the most frequent and the most costly natural catastrophe in the United States. No state in America is more familiar with flood losses than Louisiana. In an average year, one-quarter of the surface area of Louisiana is covered by meandering rivers, bayous, sloughs, swamps, lakes, and freshwater, brackish, intermediate, and salt marsh. The National Flood Insurance Program (NFIP) responds to flood losses in two fashions. First, the program makes affordable insurance available to individuals and businesses in flood hazard areas. Second, the program requires participating local governments to regulate future development of their high hazard areas in order to reduce future damages when the waters next rise. The NFIP is a remarkable phenomenon in American politics, an unpopular, grudgingly accepted program making its modest way. It is suggested that Congress examine federal assistance and disaster relief benefits to flood prone areas and that Congress should mandate a study of the degree to which upstream levees and channelization affect water stages downstream. (Peters-PTT)
W86-05963

PRINCIPLES AND LAW OF COLORADO'S NONTRIBUTARY GROUND WATER,
B. Heckman.
Denver University Law Review, Vol. 62, No. 3/4, 1985, p 809-824.

Descriptors: *Water rights, *Water law, *Legislation, *Colorado, *Groundwater, Legal Aspects, Legal Review, Groundwater management, Economics, Public policy, Well permits.

Tributary ground water, nontributary ground water found within designated basins, and nontributary ground water found outside of designated basins are defined on the basis of Colorado law. Nontributary ground water in Colorado is an anomaly. It is capable of neither common law ownership nor constitutional appropriation as defined in the Colorado Ground Water Management Act of 1965. The legislatures and the courts have thus seen fit to incorporate elements of both doctrines into a hybrid 'modified' doctrine of appropriation. The questions and conflicts must be approached with an understanding of the principles of ground water itself, namely, its hydraulics, economics, and politics. The hydrologic characteristics of legislative concern relate to ground water pressure and recharge rates. The problem of extending the water supply to obtain economic stability is subject to economic and engineering analysis. The equitable allocation of the water supply is a political problem that involves finding a balance between the public welfare and private ownership rights. Current law provides that the state engineer may issue well permits to non-designated well water but defers the determination of 'water rights' until the source of the water is established as a designated basin. (McFarlane-PTT)
W86-05991

TRANSBOUNDARY TOXIC POLLUTION AND THE DRAINAGE BASIN CONCEPT,
Fordham Univ., Bronx, NY. School of Law.
For primary bibliographic entry see Field 5G.
W86-06006

NEW SAFETY FOR OLD DAMS,
For primary bibliographic entry see Field 8A.
W86-06077

6F. Nonstructural Alternatives

EVALUATION OF FLOOD-LEVEL PREDICTION USING ALLUVIAL-RIVER MODELS.
National Research Council, Washington, DC. Advisory Board on the Built Environment.
Available from the National Technical Information Service, Springfield, VA. 22161, as PB83-171181, Price codes: A06 in paper copy, A01 in microfiche. January 1983. 127 p, 36 fig, 34 tab, 39 ref. Contract No. EMW-C-0167.

Descriptors: *Flood plain management, *Flood forcasting, *Alluvial rivers, National Flood Insurance Program, Flood channels, Channel erosion, Sedimentation, Model studies, Flow characteristics.

Many communities, primarily in the western states, have experienced problems with computing floodwater elevations for flood insurance purposes under the Federal Emergency Management Agency's National Floor Insurance Program. These problems focussed on modeling channel erosion and sedimentation using fixed-bed models for flood insurance studies in communities affected by rivers with movable beds or alluvial channels. The study involved application of six flow and sediment routing models for alluvial streams on reaches of selected rivers for which relatively complete data were available. The objective of this investigation was to determine whether river-bed degradation during flood passage has an effect on flood stafe that should be incorporated into the calculation of floodzone limits. It was concluded that, except in cases of rivers which have been severely disturbed through man's intervention through local degradation or aggradation, the use of erodible river-bed models instead of fixed bed models cannot be justified in flood insurance studies. (Author's abstract)
W86-05741

DEVELOPMENT OF A FLOOD MANAGEMENT PLAN,
Goldberg-Zoino and Associates, Inc., Newton Upper Falls, MA.
For primary bibliographic entry see Field 4A.
W86-05812

RISING WATER: THE NATIONAL FLOOD INSURANCE PROGRAM AND LOUISIANA,
Tulane Univ., New Orleans, LA. School of Law.
For primary bibliographic entry see Field 6E.
W86-05963

6G. Ecologic Impact Of Water Development

RIVER RESEARCH GETS WASHED AWAY,
S. Connor.
New Scientist NWSCAL, Vol. 107, No. 1471, p 38-40, 29 August 1985.

Descriptors: *Rivers, *Research facilities, Flora, Fauna, Frome River, Ecosystems, Research funding.

The River Laboratory is part of the U.K.'s Freshwater Biological Association (FBA). The laboratory is the center for freshwater biologists who investigate the flora and fauna of upland steams and freshwater lakes and the River Laboratory concentrates on the biology of lowland rivers, such as the Frome, which have a very different ecology. About one-third of the FBA's staff work at the River Laboratory taking up a third of the association's total funds. Most of its income comes from the National Environmental Research Council which has announced that it intends to cut its research activities. This will mean that the FBA will also lose income. (Khumbatta - PTT)
W86-05541

INTERVENTION ANALYSIS OF POWER PLANT IMPACT ON FISH POPULATIONS,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
C. P. Madenjian, D. J. Jude, and F. J. Tesar.
Canadian Journal of Fisheries and Aquatic Science CJFSBX, Vol. 43, No. 3, p 819-829, March 1986. 5 fig, 5 tab, 27 ref.

Descriptors: *Alewife, *Yellow perch, *Nuclear powerplants, *Fish populations, *Impact assessments, *Michigan, *Analysis of variance, *Intervention analysis, *F-Tests, Monitoring, D.C. Cook Nuclear Power Plant, Alosa pseudoharengus, Perca flavescens, Gill nets, Trawls, Seasonal variation, Autocorrelation, Type I errors.

Alewife (Alosa pseudoharengus) and yellow perch (Perca flavescens) abundances, estimated from monthly gillnet and trawl catches on two transects were monitored before (1973-74) and during (1975-82) operation of the D.C. Cook Nuclear Power Plant, southeastern Michigan. Intervention analysis, a technique which accounts for autocorrelated observations, and analysis of variance (ANOVA) were applied to the monitoring data to assess any plant impact. Both analyses disclosed no significant power plant impacts except for gillnetted yellow perch adults. The ANOVA indicated a significant decrease in abundance at the plant-discharge transect relative to the reference transect as plant operation began, which established a plant effect; intervention analysis showed no change. When April and May catches (months of lowest abundance) were deleted this plant effect was insignificant. Monte Carlo simulation showed that as the first-order autoregression coefficient increased positively, type I error of the ANOVA F-test increased. However, ANOVA was more powerful than intervention analysis when a first-order autoregressive component was included. Impact assessment based only on ANOVA can result in detection of impact when actually there was no effect (Type I error) when observations are serially correlated (lack independence). (Author's Abstract)
W86-05561

RESPONSES BY BENTHIC MACROINVERTEBRATES TO PROLONGED FLOODING OF MARSH HABITAT,
Delta Waterfowl and Wetlands Research Station, Portage la Prairie (Manitoba).
For primary bibliographic entry see Field 2H.
W86-05567

EFFECTS OF STREAM REGULATION ON DENSITY, GROWTH, AND EMERGENCE OF TWO MAYFLIES (EPHEMEROPTERA: EPHEMERELLIDAE) AND A CADDISFLY (TRICHOPTERA: HYDROPSYCHIDAE) IN TWO ROCKY MOUNTAIN RIVERS (U.S.A.),
Montana Univ., Bigfork. Biological Station.
S.A. Perry, W.B. Perry, and J.A. Stanford.
Canadian Journal of Zoology CJZOAG, Vol. 64, No. 3, p. 656-666, March 1986. 6 fig, 5 tab, 47 ref. EPA R-008223010.

Descriptors: *Stream regulation, *Mayflies, *Caddisfly, *Food regimes, *Deep-release dams, Density, Growth, Emergence times, Montana, Temperature, Kootenai River, Flathead River, Population dynamics, Drunella flavilinea, Hydropsyche oslari, Serratella tibialis, Development rate, Reproduction, Seasonal variation, Selective withdrawal system.

The influence of altered temperature and food regimes on the life histories of three univoltine species of aquatic insects were compared in two regulated river systems in northwestern Montana. Temperatures in both regulated rivers were more moderate than below many deep-release dams as a result of the operation of a selective withdrawal system on the dam on the Kootenai River and of major input of waters from unregulated forks in the Flathead River. Population dynamics of these species were generally highest in the regulated Kootenai River where the greatest biomass of periphyton and seston were measured. Differences in growth rates between regulated and reference stations were observed for Drunella flavilinea and Hydropsyche oslari but not for Serratella tibialis. Temperature had little effect upon total developmental time for H oslari but altered growth rates and time spend late instars. Peak emergence times were 2 to 4 wk later in regulated areas where summer water temperatures were cooler, and the duration of emergence periods was extended in regulated areas. (Author's abstract)
W86-05570

WATER INTO THE 1990'S: THE PROBLEMS OF THE DESERT BIOME,
Birkbeck Coll., London (England). Dept. of Zoology.
J. L. Cloudsley-Thompson.
International Journal of Environmental Studies IJEVAW, Vol. 25, No. 3, p 149-158, July 1985. 6 fig, 13 ref.

Descriptors: *Water supply, *Human population, *Arid lands, *Desiccation, *Groundwater, *Water importing, *Education, Prediction, Multiple land use, Development policy.

The projected increase in the world's population during the 1990's will bring increased pressure on the fragile desert environment, and desiccation undoubtedly will increase considerably. Some improvements in water supplies may come from untapped groundwater and exotic rivers, but this will be strictly limited. The only viable option lies in making better use of existing reserves through economy, conservation, and recycling waste. For this to be achieved, wide-scale education, but not necessarily literacy, will be necessary. Ecological considerations dictate the adoption of multiple land use and the avoidance of large-scale developmental projects. Water shortage need not be a greater problem of the arid lands than it is at present, although it almost certainly will be. (Author's abstract)
W86-05588

FORESTS, MAN AND WATER,
King's Coll., London (England). Dept. of Plant Sciences.
For primary bibliographic entry see Field 4C.
W86-05589

ENVIRONMENTAL IMPACT ANALYSIS IN WATER POLLUTION CONTROL,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-05591

ENVIRONMENTAL BIOTECHNOLOGY AND THE WATER INDUSTRY,
Watson Hawksley, London (England).
For primary bibliographic entry see Field 5G.
W86-05604

ENVIRONMENTAL IMPACT STATEMENT: MARTIN LAKE D AREA LIGNITE SURFACE MINE, HENDERSON, RUSK COUNTY, TEXAS.
Environmental Protection Agency, Dallas, TX. Region VI.
For primary bibliographic entry see Field 5C.
W86-05609

IMPROVEMENT OF METHODS OF LONG TERM PREDICTION OF VARIATIONS IN GROUNDWATER RESOURCES AND REGIMES DUE TO HUMAN ACTIVITY,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2F.
W86-05645

MARSHES OF THE OCEAN SHORE: DEVELOPMENT OF AN ECOLOGICAL ETHIC,
San Francisco Univ., CA.
For primary bibliographic entry see Field 2L.
W86-05747

ALABAMA COASTAL REGION ECOLOGICAL CHARACTERIZATION; VOLUME 1, COASTAL BIBLIOGRAPHY,
Geological Survey of Alabama, University.
For primary bibliographic entry see Field 2L.
W86-05748

CHESAPEAKE BAY LOW FRESHWATER INFLOW STUDY, PHASE II: BIOTA ASSESSMENT; MAP FOLIO,
Western Eco-Systems Technology, Inc., Bothell, WA.
J. Shea, and J. McFarland.
Available from the National Technical Information Service, Springfield, VA. 22161 as ADA125154, Price codes: A13 in paper copy, A01 in microfiche. May 1982. 210 p, 105 plates. Contract No. DACW31-79-C-0056.

Descriptors: *Estuaries, *Aquatic habitats, *Salinity, *Drought, *Chesapeake Bay, Model studies, Water consumption, Mapping, Aquatic animals, Phytoplankton, Invertebrates, Fish, Shellfish, Ducks, Waterfowl, Aquatic plants, Oysters, Crabs, Clams, Habitats, Maps, Consumptive use.

An assessment of the effects of low freshwater inflow conditions of the biota of Chesapeake Bay was conducted through use of data output from the U.S. Army Corps of Engineers' Chesapeake Bay Hydraulic Model. Four sets of test conditions (scenarios) were used which simulated effects of drought and effects of future consumptive water withdrawal and use as deviations from present average flow conditions. Changes in habitat of over 50 biological organisms were predicted and mapped based on salinity and other variables. Changes in habitat, which were used to delineate the amount of impact from low flow, were found to include increases and decreases depending on the species, its lifecycle, tolerances, and interactions with other organisms. The magnitude of habitat change was found to generally increase as salinity changes increased. (Author's abstract)
W86-05791

WATER MOVEMENT IN MIRELANDS,
Leningrad State Univ. (USSR). Faculty of Geography.
For primary bibliographic entry see Field 2H.
W86-05801

HISTORY OF DRAINAGE AT WICKEN FEN, CAMBRIDGESHIRE, ENGLAND, AND ITS RELEVANCE TO CONSERVATION,
Cambridge Univ. (England). Dept. of Applied Biology.
For primary bibliographic entry see Field 2H.
W86-05934

CHANGES OF IN-CHANNEL VEGETATION FOLLOWING TWO-STAGE CHANNEL CONSTRUCTION ON A SMALL RURAL CLAY RIVER,
University Coll., London (England). Dept. of Geography.
For primary bibliographic entry see Field 4A.
W86-06037

7. RESOURCES DATA

7A. Network Design

MULTIVARIATE STOCHASTIC MODEL FOR THE RECONSTRUCTION OF GROUNDWATER DATA,
Hanover Univ. (Germany, F.R.). Inst. fuer Wasserwirtschaft, Hydrologie und Landwirtschaftlichen Wasserbau.
For primary bibliographic entry see Field 2F.
W86-05669

EQUATION BASED THEORETICAL APPROACH TO NETWORK DESIGN FOR GROUNDWATER LEVELS USING KALMAN FILTERS,
Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-05671

MULTI-OBJECTIVE ANALYSIS WITH SUBJECTIVE INFORMATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6A.
W86-05811

HAPEX-MOBILHY: A HYDROLOGIC ATMOSPHERIC EXPERIMENT FOR THE STUDY OF WATER BUDGET AND EVAPORATION FLUX AT THE CLIMATIC SCALE,
American Meteorological Society, Boston, MA.
For primary bibliographic entry see Field 2B.
W86-05847

OPTIMIZATION OF WATER QUALITY MONITORING NETWORKS,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. N. Palmer, and M. C. MacKenzie.
Journal of Water Resources Planning and Management (ASCE) JWRMD5, Vol. 111, No. 4, p 478-493, October 1985, 5 fig, 1 tab, 24 ref.

Descriptors: *Water quality monitoring networks, Biological monitoring, Analysis of variance, Gradient search algorithm, Statistical models, New England.

Following a review of classical analysis of variance techniques, a modified ANOVA model with control station pairs is suggested as a cost-effective approach to the design of aquatic monitoring networks. An interactive optimization procedure is presented that incorporates a modified gradient search algorithm to select designs which maximize the statistical power of a network for a specified budget or minimize the cost of a network for a specified statistical power requirement. The sensitivity of the model results are explored as a function of the cost, the number of sampling stations, replicates, and occasions, the Type I and Type II error, estimates of data variance, and cost components for data describing an aquatic species from a New England power facility. It is shown that for specified power and cost, numerous solutions exist providing the designer with a wide selection of alternatives from which to choose. (Jones-PTT)
W86-06118

7B. Data Acquisition

COMPARATIVE STUDY OF GROUND-WATER MAPPING TECHNIQUES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
S. Rouhani.
Ground Water GWAAP, Vol. 24, No. 2, p 207-216, March-April, 1986. 7 fig, 4 tab, 15 ref.

Descriptors: *Data collection, *Mapping, *Groundwater management, Mathematical studies, Statistical analysis, Kriging, Markov process, Gauss process, Least squares method, Geohydrology.

Three main classes of interpolators for groundwater mapping were compared theoretically and numerically. These included (1) simple estimators (nearest neighbor method and arithmetic mean), (2) least squares estimators, basically fitting processes, and (3) Gauss-Markov estimators such as kriging. Results show that kriging yields relatively robust estimates. However, its suggested statistical inference method may not always produce robust estimates of the covariance function parameters. Simple estimators produce unstable results, while least squares methods ignore local variations by fitting a single polynomial function over the whole field. (Cassar-PTT)
W86-05446

GRID HISTORY: A GEOSTATIONARY SATELLITE TECHNIQUE FOR ESTIMATING DAILY RAINFALL IN THE TROPICS,
Wisconsin Univ.-Madison. Space Science and Engineering Center.
For primary bibliographic entry see Field 2B.
W86-05475

CORRELATIONS BETWEEN NIMBUS-7 SCANNING MULTICHANNEL MICROWAVE RADIOMETER DATA AND AN ANTECEDENT PRECIPITATION INDEX,
Texas A and M Univ., College Station. Dept. of

Meteorology.
For primary bibliographic entry see Field 2B.
W86-05476

MEASUREMENT OF AREAL WATER EQUIVALENT OF SNOW BY NATURAL GAMMA RADIATION - EXPERIENCES FROM NORTHERN SWEDEN,

Sveriges Meteorologiska och Hydrologiska Inst., Norrkoeping.
For primary bibliographic entry see Field 2C.
W86-05543

EVAPOTRANSPIRATION OVER AN AGRICULTURAL REGION USING A SURFACE FLUX/TEMPERATURE MODEL BASED ON NOAA-AVHRR DATA,

Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux (France).
For primary bibliographic entry see Field 2D.
W86-05549

SOURCE OF ERROR IN WATER VELOCITY MEASUREMENT FOR AQUATIC STUDIES,

Department of Fisheries and Oceans, Halifax (Nova Scotia).
D. L. Morantz, S. E. Barbour, and R. K. Sweeney.
Canadian Journal of Fisheries and Aquatic Sciences CJFSBX, Vol. 43, No. 3, p 893-896, March 1986. 1 fig, 1 tab, 9 ref.

Descriptors: *Water velocity, *Water currents, *Current meters, *Divers, *Observer effects, Ott current meter, Bentzel current speed tube, Snorkler, Errors.

Water velocity is an important component of aquatic studies but is subject to alteration by the presence of an underwater observer. Tests using two types of water velocity meter (Ott current meter and midget Bentzel current speed tube) and a snorkler showed the effects to be a function of the diver's distance from the probe. Lateral positions generally caused an acceleration of flow at the measurement point of up to 150%, whereas downstream positions resulted in a decrease of flow up to 65%. It is recommended that where underwater observers are employed, they position instruments that can be read remotely and then move well away from the point of measurement. (Author's Abstract)
W86-05564

OPERATIONAL SNOW MAPPING BY SATELLITES,

Norges Vassdrags- og Elektrisitetsvesen, Oslo.
For primary bibliographic entry see Field 2C.
W86-05626

APPLICATION OF COSMIC RAYS TO THE SOLUTION OF SOME HYDROLOGICAL PROBLEMS,

Institut Prikladnoi Geofiziki, Moscow (USSR).
For primary bibliographic entry see Field 2C.
W86-05627

WATER RESOURCES INVESTIGATIONS IN PAKISTAN WITH THE HELP OF LANDSAT IMAGERY - SNOW SURVEYS 1975-1978,

Pakistan Water and Power Development Authority, Lahore.
For primary bibliographic entry see Field 2C.
W86-05630

POSSIBILITIES AND LIMITS OF HYDROGEOLOGICAL PRESERVATION OF THE RECORD IN THE PRELIMINARY STAGE OF LARGER GROUNDWATER WITHDRAWALS AS EXEMPLIFIED BY THE NORDHEIDE WATERWORKS (NORTHERN LOWER SAXONY),

Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
H. Besenecker, and B. Schwerdtfeger.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 553-569, 5 fig, 6 ref.

Descriptors: *Hydrologic data, *Hydrogeological data, *Groundwater withdrawal, *NORDHEIDE Waterworks, *West Germany, Groundwater budget, Groundwater potential, Groundwater mining, Groundwater depletion, Aquifers, Groundwater, Homogeneity, Isotropy.

The securing of hydrogeological data prior to extensive groundwater withdrawals requires a thorough exploration of the hydrogeological conditions, a forecast of possible changes and the preparation of measures for early recognition and avoidance or reduction of possible impairments. In the NORDHEIDE waterworks project the securing of hydrogeological data was carried out in three stages: preliminary exploration, intensification of the network and detailed exploration. The results of these investigations allowed a forecast of the possible changes. In this instance it was necessary to differentiate between an estimate of sensitivity and a forecast of the drawdown development. Extent and limitations for the necessary investigations are discussed: they are dependent upon the degree of inhomogeneity and anisotropy of the area, the nature and number of conflicting usages, the degree of sensitivity of the area and the required accuracy of the forecast. (See also W86-05679) (Author's abstract)
W86-05680

DISTRICT-WIDE WATER RESOURCES INVESTIGATION AND MANAGEMENT USING LANDSAT DATA, PHASE 1: LAKE VOLUME,

Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
S. F. Shih.
Available from the National Technical Information Service, Springfield, VA. 22161, as N83-17930, Price codes: A04 in paper copy, A01 in microfiche. Final Report CR-166828, March 1982. 80 p, 9 fig, 2 tab, 3 ref, 2 append.

Descriptors: *Water resources development, *Satellite technology, *Florida, *Landsat data, *Lake volume, Water resources management, Lakes, Lake stages, Remote sensing, Lake Washington, Lake Harris.

The severe drought experienced in Central Florida throughout most of 1981 brought increased attention to the long recognized problem of fresh water availability across the State. During drought conditions, a close watch is maintained over all water supplies. This is most commonly done through monitoring water stage, the water height above sea level. Although water stage is an important indicator, water storage volume is a more critical parameter. Volume can only be obtained if accurate data exists as to the lake contours in conjunction with water stage. The University of Florida, in cooperation with the St. Johns River Water Management District, and Kennedy Space Center developed a technique using Landsat data for estimating available water storage volume and applied it successfully to Lake Washington and Lake Harris in central Florida. The technique is discussed in this study and can be applied two ways. First, where the historical stage records are available, the historical Landsat data can be used to establish the relationship between lake volume and lake stage. In the second case, where the historical stage records are not available, the historical Landsat data can be used to estimate the historical lake stage after the lake volume and lake stage information becomes available in the future. (Author's abstract)
W86-05744

ANALYSIS OF THE TANANA RIVER BASIN USING LANDSAT DATA,

National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
L. A. Morrissey, V. G. Ambrosia, and C. Carson-Henry.
Available from the National Technical Information Service, Springfield, VA. 22161, as N83-17927, Price codes: A02 in paper copy, A01 in microfiche. NASA Contractor Report 166393, April 1981. 43 p, 6 fig, 2 tab. Contract No. NAS2-11101.

The Tanana River Basin Project, as part of NASAs Applications System Verification and Transfer (ASVT) program, is a cooperative effort with agencies in the state of Alaska to assess the utility of remote sensing technology in meeting critical resource management needs, while providing DNR with baseline resource information. Digital image classification techniques were used to classify land cover/resource information in the Tanana River Basin. Portions of four scenes of Landsat digital data were analyzed using computer systems at Ames Research Center in an unsupervised approach to derive cluster statistics. Identification of the spectral classes was accomplished using the IDIMS display and color-infrared photography. Classification errors, identified during two workshops with DNR personnel, were corrected using stratification procedures. The classification scheme resulted in the following eleven categories: sedimented/shallow water, clear/deep water, coniferous forest, mixed forest, deciduous forest, shrub and grass, bog, alpine tundra, barrens, snow and ice, and cultural features. Color coded maps and acreage summaries of the major land cover categories were generated for selected USGA quadrangles (1:250,000) which lie within the drainage basin. The Tanana Project, initiated in October 1980, was completed within six months. (Author's abstract)
W86-05745

KERR RESERVOIR LANDSAT EXPERIMENT ANALYSIS FOR MARCH L98L,

Kentron International, Inc., Hampton, VA. Technical Center.
For primary bibliographic entry see Field 5A.
W86-05746

MODEL FOR ESTIMATING TIME-VARIANT RAINFALL INFILTRATION AS A FUNCTION OF ANTECEDENT SURFACE MOISTURE AND HYDROLOGIC SOIL TYPE,

Maryland Univ., College Park.
For primary bibliographic entry see Field 2G.
W86-05792

USE OF SATELLITE DATA IN RAINFALL MONITORING,

Bristol Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 2B.
W86-05802

CORRELATION OF CHLOROPHYLL CONCENTRATIONS AND SUSPENDED SOLIDS WITH NEAR-SURFACE UPWARD IRRADIANCE WITHIN LANDSAT BANDS 4, 5 AND 6,

Institute of Physical and Chemical Research, Saitama (Japan).
For primary bibliographic entry see Field 5A.
W86-05813

POSSIBILITIES OF USING THE SP-403/5 ECHOSOUNDER TO INVESTIGATE THE THICKNESS OF LAKE BOTTOM SEDIMENTS,

Akademia Rolniczo-Techniczna, Olsztyn-Kortow (Poland). Inst. of Hydrobiolgy and Water Conservation.
For primary bibliographic entry see Field 2H.
W86-05890

TRACKING A STORMY BEAST IN THE NIGHT,

For primary bibliographic entry see Field 2B.
W86-05905

COMPARISON OF FOUR ARTIFICIAL SUBSTRATES AND THE PONAR GRAB FOR BENTHIC INVERTEBRATE COLLECTION,

Geological Survey, Menlo Park, CA.
K. V. Slack, R. F. Ferreira, and R. C. Averett.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 237-248, April 1986. 4 fig, 3 tab, 58 ref.

Descriptors: *Benthic invertebrates, *Bottom sampling, *Multiple plate samplers, *Sacramento River, California, *Chironomids, *Crustaceans, Statistical analysis, Species diversity, Artificial substrates, Field tests, Error analysis, Sampling.

Four different bottom-placed artificial substrates were compared with the Ponar grab for collecting benthic invertebrates from the Sacramento River at Freeport Bridge, California. Artificial substrate samples of organisms were larger and more diverse than those of the grab. Barbeque Basket samplers caught the most taxa and individuals and Beak Trays caught the least. Chironomids and crustaceans were dominant in artificial substrate samples. Exposure habitat (left or right bank) determined taxa availability, whereas sampler design determined suitability for colonization by the taxa. Diversity of Beak Tray samples was lower than that of other artificial substrates but higher than for Ponar samples. The Barbeque Basket, Bull Basket, and Multiple Plate samplers yielded taxonomically similar collections. Ponar samples were different, and Beak Trays were of intermediate similarity. As qualitative samplers, Barbeque Baskets were 63% efficient, followed by Bull Baskets (55%), Multiple Plates (48%), Beak Trays (38%), and Ponar Grabs (6-10%). Bull Baskets required the least and Beak Trays the most replicates to be within a preselected percentage error of the mean at the 95% probability level for numbers of taxa and individuals, and for diversity. Under conditions of the study, Bull Baskets ranked highest, followed by Barbeque Baskets and Multiple Plates, in selected performance criteria. Differences between grab and artificial substrate samples are explainable in terms of major riverine habitats and characteristics of the collection methods. (Author's abstract)
W86-06018

METER STANDARDS HAVE BECOME A BARRIER TO PROGRESS,
Badger Meter, Inc., Milwaukee, WI.
D. Strobel.
Water/Engineering and Management WENMD2, Vol. 133, No. 5, p 25-28, May 1986. 2 fig.

Descriptors: *Cost analysis, *Water metering, *Design standards, American Water Works Association, Standard, Water loss, Service life, Water pressure.

The effect on water utilities of outdated cold water meter standards is discussed and suggestions are made for improved standards based on today's circumstances of materials availability and costs. Surveys have shown that 14% of all water consumption in residences is below 1/4 gal/min. The American Water Works Association standard C700-77 has 1/4 gal/min as the floor for 5/8-in meters, which means that the standard allows a substantial amount of all water consumed to pass through the meter, essentially unmetered, unnoticed, unaccounted for, and unbilled. It would be reasonable today to eliminate the 'wear factor limitation' in the standard altogether, and replace it with a standard for total registration accuracy and a parallel standard for service life. Another area of the C700 standard in great need of revision relates to 'pressure loss at safe operating capacity.' Employment of this standard would result in lower meter purchase cost by permitting practically-sized meters. The problem with the existing standard is that it inhibits the use of meters that have better accuracy at lower flow rates and lower initial costs while maintaining the required long life. (Rochester-PTT)
W86-06039

DISCRIMINATION IN THE USE OF RADAR DATA ADJUSTED BY SPARSE GAUGE OBSERVATIONS FOR DETERMINING SURFACE RAINFALL,
British Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 2B.
W86-06056

DESIGN AND LABORATORY EVALUATION OF A SIMPLE FRACTIONATING PRECIPITATION COLLECTOR,
Aberdeen Univ. (Scotland). Dept. of Soil Science.
A. C. Edwards, and M. S. Cresser.
Water, Air, and Soil Pollution WAPLAC, Vol. 26, No. 3, p 275-280, November 1985. 2 fig, 2 tab, 12 ref.

Descriptors: *Design criteria, *Rain gages, *Fractionation, Sclutes, Storms Atmosperic deposition, Chemical analysis, Rainfall simulators, Rainfall.

Routine monitoring of precipitation quantity and chemical quality is essential when estimating inputs from pollutant or natural sources. The design of a simple and inexpensive mechanical fractionating precipitation gauge is described. The device collects, sequentially, up to 12 samples of equal volume in such a way that each sample is protected from subsequent atmospheric contamination. The sampling rate may be adjusted simply by changing the diameter of the collector funnel. The gauge has been evaluated in the laboratory, and found to be useful for investigating changes in concentration of major solute components with time, through simulated storm events. It has also been found to be satisfactory under field conditions. (Main-PTT)
W86-06091

RELATIONS BETWEEN PERMEABILITY AND ELECTRICAL RESISTIVITY IN GRANULAR AQUIFERS,
San Diego State Univ., CA. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W86-06170

7C. Evaluation, Processing and Publication

PRECIPITATION ANOMALY CLASSIFICATION: A METHOD FOR MONITORING REGIONAL PRECIPITATION DEFICIENCY AND EXCESS ON A GLOBAL SCALE,
National Environmental Satellite, Data, and Information Service, Washington, DC. Climate Analysis Center.
For primary bibliographic entry see Field 2B.
W86-05461

METHOD OF WORKING AND EMPLOYMENT OF EDP DURING THE PREPARATION OF GROUNDWATER VULNERABILITY MAPS,
Niedersaechsisches Landesamt fuer Bodenforschung, Hanover (Germany, F.R.)
T. Haertle.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1073-1985, 9 fig, 10 ref.

Descriptors: *EDP, *Subsurface mapping, *Groundwater pollution, Groundwater potential, Maps, Permeability, Aquifers, Water level.

In order to be able to assess groundwater vulnerability in water-table or unconfined aquifers, the layers covering the groundwater are assessed according to their composition and thickness. In this process, layers are differentiated into three grades of vulnerability. With the help of EDP, delimination of the layers covering the groundwater is carried out on the basis of permeabilities and water level. After that, a map of scale 1:25,000 is produced on which symbols are plotted at the respective well site, to which specific grades of vulnerability can be allotted. The map serves as a working aid for surface delimination of the various grades of vulnerability. The final results are presented on a scale of 1:200,000. (See also W86-05679) (Author's abstract)
W86-05723

HYDROCHEMICAL MAPS AS BASIC INFORMATION FOR THE PROTECTION OF GROUNDWATER,
Grosser Erftverband, Bergheim (Germany, F.R.).
V. Schenk.
IN: Ground Water in Water Resources Planning, IAHS Publication No. 142, 1983. Volume II: Proceedings of a Symposium, Koblenz, West Germany, August 28-September 3, 1983. p 1193-1202, 3 fig, 2 ref.

Descriptors: *Maps, *Hydrologic maps, *Groundwater, *Water pollution control, Industrial wastes, Groundwater management, Groundwater pollution. Rhine River, Germany.

The southern part of the Lower Rhine Basin is one of the geologically and hydrologically best known parts of Germany. One reason for this is the necessity to watch the enormous groundwater dewatering operations which have to be done in order to keep these large open cast lignite mines dry. As a result of industrialization, the population increased and that caused the necessity for an efficient public water supply. The hydrological effects of these operations have to be controlled in the same way as those of the industry, hence there exists a large net of wells and groundwater-observation wells (about 8,500). The Grosser Erftverband (GEV), an institution which has to deal with groundwater problems by governmental order, uses most of them for hydrochemical investigations too. The GEV started to produce hydrochemical data, which covers the total region and which also explains all important connections. In this way an objective base for the preventive protection of groundwater is given. Hydrochemical maps are an optimum way to present a survey of all the facts which are important for the protection of groundwater. Most of the maps in use now, do not give a satisfactory relation to time, which is very important for predictions. For this aim, specific proposals to improve the contents of quality development information in hydrochemical maps are discussed. (See also W86-05679) (Lantz-PTT)
W86-05732

HYDROLOGICAL ANALYSIS FOR THE PLANNING OF SMALL HYDROPOWER PLANTS,
For primary bibliographic entry see Field 2E.
W86-05737

PRECIPITABLE WATER: ITS LINEAR RETRIEVAL USING LEAPS AND BOUNDS PROCEDURE AND ITS GLOBAL DISTRIBUTION FROM SEASAT SMMR DATA,
Jet Propulsion Lab., Pasadena, CA.
For primary bibliographic entry see Field 2B.
W86-05742

ESTIMATION OF HYDRAULIC DATA BY SPLINE FUNCTIONS,
Kanazawa Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-05859

COMPUTERIZATION OF SEWER MAINTENANCE SCHEDULING PART 1 - PRINCIPLES OF OPERATION,
Schaaf and Wheeler, San Jose, CA.
J. R. Schaaf.
Public Works, Vol. 116, No. 9, p 128-129, September 1985. 2 fig, 2 tab.

Descriptors: *Sewer systems, *Maintenance, *Computer programs, Wastewater treatment, San Francisco, Management planning, Performance evaluation, Data storage and retrieval.

Maintenance of a sanitary sewer collection system is a costly budget item. In this era of increasing budgetary problems, there is a need to upgrade and modernize the sanitary sewer maintenance function. Merging the card system with modern data processing equipment and techniques, holds bright promise for upgrading sanitary sewer maintenance operations. Such a merger has been developed for three sanitary/sanitation districts in the San Francisco Bay area, and has been given the acronym of COSMO, standing for Computerization of Sewer

Maintenance Operations. The two purposes of COSMO are to store data and to aid in scheduling routine cleaning operations. The four principal elements of COSMO are: the Data Base, the Criteria, the Analysis Program, and the Scheduler. The Data Base contains information on the systems physical attributes as well as data from previous cleaning, construction, repair, and TV operations. The Criteria are a set of goals and objectives translated into a form capable of being used by a digital computer. These criteria contain measures of effectiveness and a set of operational rules, which govern the logic and compare the various cleaning strategies. The Analysis Program provides informational reports to the manager and the maintenance department, which present relevant data for performance tracking. The Schedule prepares a cleaning schedule and reports it to the maintenance superintendent. (Khumbatta-PTT)
W86-05879

ANATOMY OF A RAINFALL INDEX,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 2B.
W86-06052

AUTOMATIC METHOD FOR ON-LINE ESTIMATION OF THE PHOTOSYNTHETIC RATE IN OPEN ALGAL PONDS,
Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Electrical and Computer Engineering.
For primary bibliographic entry see Field 2H.
W86-06104

METHODOLOGY FOR ESTIMATING NUMBERS OF FREE-LIVING AND ATTACHED BACTERIA IN ESTUARINE WATER,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 2L.
W86-06139

WATER QUALITY SURVEYS: A STATISTICAL METHOD BASED ON DETERMINISM, QUANTILES AND THE BINOMIAL DISTRIBUTION,
Victoria Environment Protection Authority, East Melbourne (Australia).
A. J. R. Cotter.
Water Research WATRAG, Vol. 19, No. 9, p 1179-1189, 1985. 3 fig, 3 tab, 31 ref, append.

Descriptors: *Mathematical studies, *Water quality, *Statistical methods, *Statistical analysis, *Sampling, Temporal distribution, Spatial distribution, Statistics, Surveys, Water quality management, Water management.

A statistical method for surveying water quality and analyzing the results in terms of quantiles is described. The value of a water quality variable in a grab-sample is taken as a deterministic function of the temporal and spatial coordinates of the sampling point. Quantiles can then be defined for any specified region in time and space as unique, fixed values, and randomly located grab-samples may be used to estimate them for the purposes of describing or regulating water quality. Robust statistical inferences are possible using the binomial distribution. Properties of the quantiles, confidence limits, comparisons with fixed values or between regions, assessment of trends, simultaneous inferences and estimation of sample sizes are discussed. Two examples of water quality surveys, one Port Philip Bay, the other of the Maribyrnong River, Victoria, are used to illustrate the theory, paying particular attention to practical problems which arose. The proposed method is compared with others based on stochastic models, and is claimed to be simpler and more reliable. (Author's abstract)
W86-06159

8. ENGINEERING WORKS

8A. Structures

ANALYSIS OF PIPE BREAKAGE IN URBAN WATER DISTRIBUTION NETWORKS,
Manitoba Univ., Winnipeg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W86-05469

RE-EXAMINATION OF SLIDE OF LOWER SAN FERNANDO DAM,
Geotechnical Engineers, Inc., Winchester, MA.
For primary bibliographic entry see Field 8D.
W86-05555

PLANNING, DESIGN AND CONSTRUCTION OF THE GREAT GRIMSBY SEWAGE OUTFALL,
Anglian Water Authority, Lincoln (England). Lincoln Div.
C. Mason, K. J. Flemons, and A. G. Taylor.
Institution of Civil Engineers Proceedings PCIEAT, Vol. 78, Part 1, p 1045-1064, October 1985. 11 fig, 3 tab, 3 ref, appendix.

Descriptors: *Great Grimsby sewage outfall, *Outfalls, Construction, Planning, Dispersion, Dredging, Flow discharge, Design standards, Outfall, Estuaries, Materials engineering.

The paper outlines the pollution problems in the Humber estuary and the need for replacing the existing sea outfalls to provide an acceptable standard of discharge. Bacteriological surveys, biological surveys, water movement in the estuary, marine site investigations, and preliminary costing are described and performed in the feasibility stage of the planning process. Design considerations are dealt with including pipe materials and method of laying. The construction of the outfall is described in detail with reference also being made to the dredging operation and the installation of the diffuser units under the difficult conditions encountered in the estuary. (Khumbatta-PTT)
W86-05593

DESIGN AND CONSTRUCTION SUPERVISION OF SEA WALL AND BREAKWATER AT TORNESS POWER STATION,
Williamson (James) and Partners, Edinburgh (Scotland).
A. I. Will, T. A. F. Willis, and D. D. S. Smith.
Institution of Civil Engineers Proceedings PCIEAT, Vol. 78, Part 1, p 1165-1189, October 1985. 16 fig, 2 tab, 13 ref.

Descriptors: *Torness Power Station, *Design standards, *Construction, *Breakwaters, Dolos armouring, Berths, Sea walls, Docks.

Design criteria and design studies for the sea wall and breakwater at the Torness Power Station are described in this paper. The preliminary design is outlined and the design finally adopted is described in detail. The final design incorporated dolos armoring and the paper discusses the casting, placement and testing of the dolos units. Other features of the design of the marine works, including the breakwater protecting the roll-on /roll-off berth and barge-landing facility are described. (Khumbatta-PTT)
W86-05594

FIELD STUDIES ON THE INTERCHANGE OF SURFACE WATER AND GROUND WATER,
Institut fuer Wasser- und Abfallwirtschaft der Landesanstalt fuer Umweltschultz, Karlsruhe (Germany, F.R.).
For primary bibliographic entry see Field 4B.
W86-05710

WEIR INSTALLATIONS AND WEIR GATES IN LOW-HEAD POWER SCHEMES,
H. Simmler.
IN: Symposium on Project Design and Installation of Small Hydro Power Plants, Vienna, Austria, June 29-July 1, 1981. p 81-104, 22 fig, 9 ref.

Descriptors: *Weirs, *Weir gates, *Hydroelectric plants, *Installation, Dams, Barriers, Hydraulic gates, Gates.

Weirs suited for mini hydro stations are discussed. Dam builders differentiate between fixed-crest structures, which are simple in design and, under certain conditions, can even be used for diversion-type power stations, and gate-controlled structures or barrages, which offers a great variety of design and contruction possibilities. In view of their use in hydro power, the discussion should include location problems resulting from bed load transport and aspects of fluid mechanics. A thorough analysis is made of the gate systems used in the construction of mini hydro stations, and of their function and operation in order to permit appraisal of different gate types and their applications. Finally, a weir type is described which has been increasingly used over the last few years, such as the inflatable dam. Compared with the conventional gate structures, this is low in cost and, according to the experience gathered so far, represents a safe, automatically controlled gate system. (See also W86-05734) (Author's abstract)
W86-05738

WATER CONVEYANCE STRUCTURES IN LOW-HEAD HYDRO-DEVELOPMENTS,
S. Radler.
IN: Symposium on Project Design and Installation of Small Hydro Power Plants, Vienna, Austria, June 29-July 1, 1981. p 123-136, 10 fig, 2 ref.

Descriptors: *Conveyance structures, *Water conveyance, *Hydroelectric plants, Open channels, Water management, Economic aspects.

The typical water conveyance facility in low-head power developments is the open water channel. The point at which flow is developed for energy generation divides the waterway into an upstream part and a downstream part. This division is made according to topographical and geological aspects as well as in terms of water management and is reflected by economic considerations in that the upstream conveyance structures are usually concrete-lined whereas the downstream part, or tailrace, is normally not. The waterways of mini hydro developments are generally subject to the same rules, design principles and construction materials as apply for other hydro plants. Special designs and construction methods may sometimes be dictated by the unusual characteristics of a project site. Departures from conventional designs are possible in view of the small magnitude of the design data involved. (See also W86-05734) (Author's abstract)
W86-05739

GENERAL FORMULA FOR CALCULATING THE PROBABILITY OF FAILURE OF WATER PROJECTS AND ITS POTENTIAL APPLICATIONS,
East China Technical Univ. of Water Resources, Nanjing.
C. Shuzheng.
Journal of Hydrology JHYDA7, Vol. 80, No. 1/2, p 111-124, September 1985. 3 fig, 6 tab, 13 ref.

Descriptors: *Design flood, *Probability of failure, *Flood protection, Mathematical studies.

The estimation of an appropriate design flood which can satisfy the specified design probability is important to both hydraulic and hydropower projects. An approach using true 100 p percentile of the distribution of x, where x is the studied flood-flow variable and xp, the design flood is described. The expected probability of xp can be treated as a synonym of the probability of failure. The expected probability of the traditional design flood satisfying the unbiased condition will always be much greater than the design probability 1-p; therefore, the traditional approach for selecting the design flood cannot satisfy the requirement for

intended safety and it is necessary to find an appropriate design flood x0p satisfying the probability of failure, $p(x > x0p) = 1-p$. (Adams-PTT)
W86-05836

MODERN TECHNIQUES IN WELL DESIGN,

Geoscience Support Services, Inc., Pomona, CA.
D. E. Williams.
American Water Works Association Journal JAWWA5, Vol. 77, No. 9, p 68-74, September 1985. 14 fig, 7 ref.

Descriptors: *Well design, *Design criteria, Wells, Well screens, Laminar flow, Turbulent flow.

A direct benefit of efficient wells is reduced pumping costs. Well efficiency is controlled by several factors, including aquifer, drilling damage, and turbulent-flow losses at or near the well screen. Screen entrance velocity is not a critical design factor if values are <2-4 fps (0.6-1.2 m/s). For most wells, the required open area of a screen need only be 3-5%. A new method of designing minimum length of well screen based on laminar flow-turbulent flow considerations is presented, along with a simple field test to calculate the efficiency of an existing well or to provide a criterion for termination of development of a newly constructed well. (Author's Abstract)
W86-05870

BRECON FLOOD ALLEVIATION SCHEME,

MacDonald (M.) and Partners, London (England).
For primary bibliographic entry see Field 4A.
W86-05904

TWO-DIMENSIONAL DAM-BREAK FLOOD-FLOW ANALYSIS FOR ORANGE COUNTY RESERVOIR,

Williamson and Schmid, Irvine, CA.
T. V. Hromadka, II, and T. J. Durbin.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 249-255, April 1986. 9 fig, 11 ref.

Descriptors: *Hydrologic models, *Model studies, Two-dimensional models, *Flood flow, *Dam failure, *California, *Orange County, Brea, Continuity equations, Momentum equations, Numerical solutions, One-dimensional models, Flooding, Shallow water.

A two-dimensional dam-break model was used to predict the inundated area on an alluvial fan downslope from the Orange County Reservoir, near Brea, California. The model is based on a diffusion form of the continuity and momentum equations for long waves in shallow water, and the governing equation is solved by an explicit numerical scheme. In a comparison with a one-dimensional model, the two-dimensional model predicts a wider inundated area because the two-dimensional model better represents the hydrodynamics of the actual field situation. (Author's abstract)
W86-06019

TWO-DIMENSIONAL DIFFUSION-PROBABILISTIC MODEL OF A SLOW DAM BREAK,

California Univ., Irvine. Dept. of Civil Engineering.
G. L. Guymon, and T. V. Hromadka, II.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 257-265, April 1986. 7 fig, 2 tab, 13 ref.

Descriptors: *Dam failure, *Hydrologic models, *Flood waves, *St. Venant equations, Two-dimensional models, Shallow water, Flood hydrographs, Channel roughness, Long Valley Dam, Owens River, Bishop, California, Partial differential equations, Numerical analysis.

A two-dimensional model of a dam-break flood wave was developed by simplifying the St. Venant equations to eliminate local acceleration and inertial terms and combining the simplified equations with continuity to form a diffusion type partial differential equation. This model is cascaded with a two point probability estimate scheme to account for uncertainty in the dam break flood hydrograph and channel roughness. The development and application of the probabilistic model is the main contribution of this paper. The approach is applied to a hypothetical dam break of Long Valley Dam, on the Owens River above Bishop, California. The results indicate that a rather wide range of roughness coefficient and input dam break flood hydrograph does not significantly affect the extent of the flood plain. However, varying these factors significantly affects the speed of travel of the flood wave and local discharge per unit width values. Parameter variability affects the shallower water depths more than where water depths are larger; the deterministic diffusion model may be less accurate for shallower water depths. (Rochester-PTT)
W86-06020

GRAVITY PRESSURE COLLECTION SYSTEM DRAINS VIADUCT,

Howard, Needles, Tammen, and Bergendoff, Kansas City, MO.
F. A. Uribe, and R. E. Schwab.
Public Works PUWOAH, Vol. 117, No. 6, p 65, June 1986.

Descriptors: *Highways, *Viaducts, *Storm sewers, Kansas City, Missouri, Kansas, Paving, Floods, Pressure conduits.

The design and construction of a collection system to drain stormwater from the surface of the Interstate 670 viaduct near the Kansas River at Kansas City, Kansas, and Kansas City, Missouri, are described. This 23-acre paved watershed was designed to stand about 55 ft above the flood plain, well above river stages and levees. This made possible the design of a gravity-pressure collection system, in which roadway scuppers intercept the flow, downspouts conduct the flow to the ground and act as standpipes, and an underground pressure-tight storm sewer network delivers the flow to the river. At high stages, the head in this system forces the stormwater into the river; at low river stages, the system behaves as an ordinary gravity flow system. Although construction cost for the east side system is $650,000 and for the west side is $700,000, the savings will be about $1.5 million compared to a gravity-pumping alternative. (Rochester-PTT)
W86-06044

HOUSTON OPTS FOR WATER PLANT EXPANSION,

Dannenbaum Engineering Corp., Houston, TX.
For primary bibliographic entry see Field 5F.
W86-06048

SOLUTIONS IN THE PIPELINE,

JSC International Engineering, Sacramento, CA.
B. J. Schrock.
Civil Engineering/ASCE, Vol. 55, No. 9, p 46-49, September 1985. 5 photos.

Descriptors: *Pipelines, *Pipe collapses, *Sewers, *Maintenance, Conveyance structures, Water mains, Pipeline stoppages, Pipes, Damaged pipes.

Sewer pipeline stoppages and collapses are increasing at a rate of about 3% per year, approximately 500,000 cases in 1984. Roots puncturing and growing inside the pipes cause >50% of the stoppages; a combination of roots, corrosion, soil movement and inadequate construction cause the bulk of the structural failures. Because of the growing rate of failure, about 75% of the nation's piping systems today are performing at 50% of capacity or less. Due to the expense, traffic disruptions and inconveniences of open-cut replacement of pipelines, local officials are always searching for low-impact rehabilitation techniques. Today, communities are using two improved techniques which reduce costs of pipeline rehabilitation. One is structural rehabilitation to minimize collaspes. The other is a philosophy of closing holes to reduce extraneous flows into the pipe and to minimize the need to respond only to crises. (David-PTT)
W86-06076

NEW SAFETY FOR OLD DAMS,

R. Robison.
Civil Engineering (ASCE), Vol. 55, No. 9, p. 60-63, September 1985. 4 photos.

Descriptors: *Dams, *Safety, *Structural engineering, Pennsylvania, Barriers, Structural behavior, Legislation, Cost analysis.

When a privately owned dam at an Italian mine collapsed in July, killing more than 200 persons in the resort village of Stava, repercussions were heard throughout the U.S. Suddenly federal and state dam safety programs were big news again, four years after the mammoth Phase I inspection. The newsmedia wanted to know why many of the 3,000 dams defined as 'unsafe' after the inspection haven't all been repaired. The reason: it takes considerable time and money to attack such large infrastructure problems. Nevertheless, Phase 1 struck a collective nerve in flood-prone Pennsylvania, the state farthest along in its dam rehabilitation program. The legislature quickly authorized $300 million for the repair of dams, ports and other components of the water supply infrastructure. Funded by periodic issues of general obligation bonds, the money is available as loans to both public and private owners. The number of unsafe dams had been reduced from 208 in 1981 to about 100 now, by having the Department of Environmental Resources negotiate consent agreements with owners to bring the dams into compliance. (David-PTT)
W86-06077

RUBBLE MOUNDS: HYDRAULIC CONDUCTIVITY EQUATION,

New Orleans Univ., LA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W86-06109

RUBBLE MOUNDS: NUMERICAL MODELING OF WAVE MOTION,

New Orleans Univ., LA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W86-06110

DAMAGE TO ARMOR UNITS: MODEL TECHNIQUE,

Waterloopkundig Lab. te Delft (Netherlands).
K. den Boer.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE), JWPED5, Vol. 111, No. 5, p 817-827, September 1985, 13 fig, 1 tab, 3 ref.

Descriptors: *Armor units, *Modeling techniques, *Dolosse damage, *Breakwaters, Gioia Tauro Italy, Storms.

After a storm on December 31, 1979 and January 1, 1980, with a maximum significant wave height of 23.3 ft, a large number of broken Dolosse of 15 metric tons was observed on the west breakwater of Gioia Tauro, Italy. The storm was reproduced in a model at a scale of 1 to 45.5 and stable modified design was determined. The model technique used single frame film exposures to detect rocking of Dolosse. The number of rockings plus the number of displaced Dolosse observed in the model corresponds well to the number of broken Dolosse in nature. This conclusion is only valid for the slope above still-water level. (Author's abstract)
W86-06111

STABILITY OF ARMOR UNITS ON COMPOSITE SLOPES,

Delaware Univ., Newark. Dept. of Civil Engineering.
N. Kobayashi, and B. K. Jacobs.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 111, No. 5, p 880-894, September 1985, 9 fig, 2 tab, 17 ref.

Descriptors: *Berms, *Armor units, *Composite slopes, *Slope protection, *Bank protection, *Riprap, Sandbags, Wave runup, Wave height, Saville's method, Model studies.

Riprap and sandbag model tests were conducted in a wave flume to investigate the effects of berm-type slopes on the stability of armor units and wave runup as compared to uniform slopes. Measurements of wave runup, rundown, wave height, breaker type and the response of armor units under regular wave action were made for each test run. The uniform and composite slope test results were analyzed using a modified Saville's method which accounts for the overall effects of the slope configuration on the stability of armor units and wave runup. A simple analysis procedure based on the proposed method is developed for a preliminary design of a berm configuration. An example computation is made for a composite slope protected with riprap. The berm width, the berm slope and the water depth at the shallowest point of the berm are varied so as to determine the optimal berm configuration for increasing the stability of riprap under the assumed wave conditions. (Author's abstract)
W86-06112

LOCKS WITH DEVICES TO REDUCE SALT INTRUSION,

Waterloopkundig Lab. te Delft (Netherlands).
P. van der Kuur.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE), JWPED5, Vol. 111, No. 6, p 1009-1021, November 1985, 15 fig, 5 ref.

Descriptors: *Locks, *Dikes, *Gates, *Saline water intrusion, Netherlands, Hydraulic engineering.

Navigation locks can strongly influence the water management of an area (both quantity and quality) especially if they belong to a retaining dike separating saltwater from fresh water. These locks consume fresh water for the locking process. An extra quantity is also needed for the reduction of salt intrusion. In the past 30 yr. various locks with devices to reduce the salt intrusion have been developed, especially in The Netherlands. The state of the art of this development is presented. The performance of the various devices is also described. The major characteristic of the development is a decreasing consumption of fresh water to reduce the salt intrusion combined with an increasing complexity of the devices. (Author's abstract)
W86-06115

GROUND-WATER DAMS FOR RURAL-WATER SUPPLIES IN DEVELOPING COUNTRIES,

VIak AB, Vallingby (Sweden).
G. Hanson, and A. Nilsson.
Ground Water GRWAAP, Vol. 24, No. 4, p 497-506, July-August 1986. 15 fig, 1 tab, 20 ref.

Descriptors: *Artificial recharge, *Induced infiltration, *Water supply development, *Rural areas, *Developing countries, Groundwater management, Groundwater development, Dams, Aquifers, Groundwater reservoirs, India, Ethiopia, Sand.

By storing water behind subsurface dams in natural aquifers, or in the sand accumulated in sand storage dams, many of the disadvantages of conventional surface storage, such as high evaporation rates, pollution, siltation, and health hazards, may be avoided. The techniques are very old, but only recently have there been some attempts to make systematic studies and to develop proper siting, design, and construction methods. This paper presents the experience gained from existing structures all over the world and describes the physical settings where these techniques may be applied. Design and construction alternatives are shown, and case studies from India and Ethiopia are presented. The construction of groundwater dams may be a feasible solution to water supply problems in many parts of the world if preceded by proper planning and site surveys. (Author's abstract)
W86-06174

8B. Hydraulics

RIVER RSPONSE TO DREDGING,

Resource Consultants, Inc., Fort Collins, CO.
P. F. Lagasse.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 112, No. 1, p 1-14, January 1986. 8 fig, 2 tab, 25 ref.

Descriptors: *Dredging, *Bed-load sediments, *River mechanics, *Channel morphology, *Dikes, *Spoil disposal, Sedimentation, Navigation channels, Transport, Mississippi River, Columbia River, Morphology, United States, Long-term Changes, Alluvial sediments, Dike fields, Channel improvement.

Examination of the impact of dredging when employed in support of engineering requirements for river system development on the Mississippi River system reveals that the dredge provides the river engineer with a means of rapidly altering channel configuration and accelerating morphologi processes. Dredging and disposal of dredged material in support of channel maintenance implies the repeated moving of alluvial sediments from the main channel region toward the periphery of the channel. The combined use of dredging, contraction dikes, and disposal of dredged material in the dike fields can induce major changes in the cross-sectional characteristics of a river. This direct physical displacement of bed material and the resulting change in channel shape can retard the movement of bed-load sediments through a river system. In both the Columbia and Mississippi River systems, this lateral redistribution of sediment by dredging, when combined with contraction works, has constituted an agent for long-term morphologic change. (Rochester-PTT)
W86-05499

SHIP SIMULATION MODELS: AN AID TO HARBOR DESIGN,

Maritiem Research Inst. Nederland, Wageningen.
R. P. Dallinga, T. Elzinga, and R. H. M. Huijsmans.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 112, No. 2, p 255-268, March 1986. 16 fig, 1 tab, 17 ref.

Descriptors: *Harbor design, *Ship simulation models, *Ports, *Cost-benefit analysis, Ship motions, Transport volume, Channels, Port entrances, Optimization, Horizontal ship motions, Vertical ship motions.

In the design and development of ports, cost-benefit analyses are often used to select the final design. These analyses show on the one hand the capital and maintenance costs for dredging and investment costs, and the benefits of a larger transport volume. The economy of a port is substantially influenced by the dimensions of approach channels and port entrances. To determine optimal dimensions of a harbor, the vessels that will call at the port have to be considered, because the channel and port dimensions are largely influenced by the behavior of the vessels. In the prediction of ship motions, simulation techniques have proven to be adequate tools. Two such simulation techniques are discussed here: one related to horizontal ship motions and the other related to vertical ship motions. Simulation models for horizontal ship motions may result in significantly smaller channel dimensions than applying conventional guidelines. The mathematical description of a vertical ship motion showed satisfactory agreement with model test results and, therefore, this mathematical description is useful for design purposes. It is concluded that medium scale simulators can offer a cost-effective approach at different design stages of ports and fairways. (Rochester-PTT)
W86-05506

DYNAMIC RESPONSE OF CAISSON PLATE TO WAVE IMPACT,

Cukurova Univ., Adana (Turkey). Dept. of Civil Engineering.
M. S. Kirkgoz, and Y. Mengi.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 112, No. 2, p 284-295, March 1986. 10 fig, 12 ref.

Descriptors: *Caisson plates, *Wave impact, *Wave action, *Breakwaters, *Theoretical analysis, Composite construction, Elastic plate theory, Dynamic magnification factor, Dynamics, Coastal engineering, Finite elements method, Mode superposition technique.

The dynamic behavior of a caisson plate subjected to wave impact load was studied. Impact pressure data are taken from recent experimental work. In the dynamic analysis of the caisson plate the classical elastic plate theory is used and the numerical results for the dynamic values of moments and transverse displacement are obtained by employing the method of finite elements together with a mode superposition technique. A new criterion is proposed to determine the number of modes to be considered in the analysis. The time histories of the moments and transverse displacement exhibit similar patterns and the dynamic values are considerably greater than the static values. The latter values are obtained by representing the maximum impact pressure distribution as a static load. A procedure for the dynamic design of caisson plates is proposed that is based on the dynamic magnification factor. (Rochester-PTT)
W86-05507

SELF-CLEANING SLOPE FOR PARTIALLY FULL SEWERS,

Rose-Hulman Inst. of Tech., Terre Haute, IN. Civil and Mechanical Engineering Div.
R. E. Benson, Jr.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 111, No. 6, p 925-928, December, 1985. 2 fig, 1 tab, 1 ref.

Descriptors: *Sewers, *Self-cleansing slope, *Mathematical equations, Sewer systems, Mathematical models, Flow rates, Flow velocity, Mathematical analysis.

Most of the time in sewers, actual flow rate will be a fraction of the design flow rate, flow velocities will be at a minimum, and the concern for preventing deposition is the greatest. Therefore, mathematical relations are needed to describe the velocity of flow for partially full sewers. These relations including velocity and slope are presented. The final equation presented is believed to provide the self-cleaning slope to meet actual design conditions. In this manner, if the flow ratio is known for the minimum flow conditions for which the self-cleansing velocity is required, then the self-cleansing slope may be determined for the selected minimum velocity. (Main-PTT)
W86-05535

TRANSIENT GROUNDWATER FLOW IN TWO AQUIFER SYSTEMS DUE TO CIRCULAR AND RECTANGULAR WELL FIELDS,

Wuhan Inst. of Hydraulic and Electric Power Engineering (China).
For primary bibliographic entry see Field 4B.
W86-05713

USING THE DWOPER ROUTING MODEL TO SIMULATE RIVER FLOWS WITH ICE,

Cold Regions Research and Engineering Lab., Hanover, NH.
S. F. Daly, and G. D. Ashton.
Available from the National Technical Information Service, Springfield, VA. 22161 as ADA 125439, Price codes: A03 in paper copy, A01 in microfiche. Special Report 83-1, January 1983. 19 p, 8 fig, 10 ref.

Descriptors: *Hydraulics, *Ice, *Rivers, Model studies, Dynamic Wave Operational Forecast Program, DWOPER model, Mathematical models, Floods, Flow pattern, Simulation, Melting, Ice breakup.

The Dynamic Wave Operational Forecast Program (DWOPER) was studied to determine what modifications would be required to include the effect of river ice on the flow variables of water level and discharge. Although modification of hydraulic roughness, cross-sectional area, and the hydraulic radius produced transients which qualitatively resembled real conditions; further work is

necessary to predict behavior from fall to spring behavior from fall to spring breakup. In general, the steeper the channel, the greater the transient response. To describe the problem more fully: (1) use a weighting factor that could be varied in response to the changing ice conditions; (2) obtain more information on the physics and mechanics of lateral ice growth, longitudinal ice flow growth, ice cover initiation by bridging or arching, and ice cover breakup; (3) investigate the transient response of channels and rivers to ice processes; (4) gather more field data, particularly in the realm of remote sensing of ice thickness; and (5) study the effect of ice jams as opposed to uniform ice cover. (Cassar-PTT)
W86-05795

OPTIMAL CONTROL OF SEA LEVEL IN A TIDAL BASIN BY MEANS OF THE PONTRYAGIN MAXIMUM PRINCIPLE,

Osservatorio Geofisico Sperimentale, Trieste (Italy).
R. Mosetti.
Applied Mathematical Modelling AMMODL, Vol. 9, No. 5, p 321-324, October 1985. 5 fig, 9 ref.

Descriptors: *Tidal basins, *Water levels, *Flood control, *Optimal control theory, *Sea level, *Tides, Mathematical models, Bays, Lagoons.

The control of water level in tidal basins, such as bays and lagoons, is necessary for defense from storm surges, creation of water reservoirs, and conversion of tidal energy. It is difficult to optimize the control operations that are made by qualitative judgements. Therefore, mathematical models to determine the best control strategies are desirable. The optimal control strategies are desirable. The optimal control theory uses a mathematical model to study, in this case, tidal fluctuations in a basin under gate operations where there is minimal reduction of basin mouth. Application of optimal control theory to water level management in this basin shows great possibility for practical use and illustrates the significant modifications that occur in response of the tidal basin through partial closure of the basin itself. (Adams-PTT)
W86-05829

REGIONALIZATION OF FLOW DURATION CHARACTERISTICS,

National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. Mimikou, and S. Kaemaki.
Journal of Hydrology JHYDA7, Vol. 82, No. 1/2, p 77-91, November 1985. 5 fig, 5 tab, 11 ref.

Descriptors: *Hydroelectric power, *Flow duration, Water availability, Model studies, Areal precipitation, Hyposometric analysis.

Hydropower potential at a certain site depends on the water availability and hydraulic head. The flow duration curve, or the estimate of flow availability, is of concern to the hydraulic design. The monthly flow duration characteristics of eleven major flow measuring sites across Greece were analyzed. Geographic variations are explained in terms such as mean annual areal precipitation, the drainage area, the hyposometric fall and the length of the main river course from the divide of a drainage basin to a certain site. This regional technique may be useful in estimating water availability for hydropower at ungaged sites or for water supply and water quality projects. (Adams-PTT)
W86-05838

MECHANICS OF FLUIDS (MECANIQUE DES FLUIDES),

Lille-1 Univ., Villeneuve d'Ascq (France). Lab. de Mathematiques Pures et Appliquees.
A. Dyment, and A. Boudlal.
Comptes Rendu Academie de Science, Paris CHDCAQ, Vol. 302, Ser. II, No. 7, p 387-390, February 21, 1986. 2 ref.

Descriptors: *Waves, *Solitary waves, *Gravity waves, *Fluid mechanics, Stratified flow, Hydraulics, Channels.

Long internal gravity waves are studied in a horizontal duct containing two stratified fluids. It is shown that progressive indeformable waves of conidial type, can exist. The nature of these waves depends on the undisturbed flow data, on the density ratio and also on fundamental derivatives which are function of the shape of the duct only. (Doria-PTT)
W86-05893

CHARACTERISTICS OF FREE SURFACE FLOW OVER GRAVEL BED,

Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 2E.
W86-05915

BRINK DEPTH IN NONAERATED OVERFALLS,

National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
G. C. Christodoulou.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 111, No. 4, p 395-403, December 1985. 6 fig, 12 ref.

Descriptors: *Spillways, *Brink depth, *Irrigation canals, *Irrigation engineering, Fluid drop, Irrigation, Residual pressure, Mathematical equations, Momentum equation.

Small drop structures employed in irrigation canals are often not ventilated. The importance of the residual pressure at the brink of a rectangular overfall is quantified by means of the 1-D momentum equation. The pressure acting below the nappe under nonaerated conditions is studied experimentally and correlated to the drop height in nondimensional terms. Comparisons are made with relevant results for ventilated drop structures and criterion for defining a low drop is proposed. The results of pressure estimates were subsequently used for an approximate theoretical evaluation of the brink depth ratio, based on the one-dimensional momentum equation and neglecting the effects of friction and slope in the upstream channel. Comparison with experimental data indicates that the proposed theoretical approach can be employed for a reasonably accurate prediction of the brink depth under nonaerated conditions. (Doria-PTT)
W86-05922

SURFACE IRRIGATION OPTIMIZATION MODELS,

Concepcion Univ. (Chile). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 3F.
W86-05923

DISCHARGE CHARACTERISTICS OF FLOW PAST A FLOOR SLOT,

Concordia Univ., Sir George Williams Campus, Montreal (Quebec). Dept. of Civil Engineering.
A. S. Ramamurthy, and M. G. Satish.
Journal of Irrigation and Drainage Engineering (ASCE) JIDEDH, Vol. 112, No. 1, p 20-27, February 1986. 6 fig, 14 ref, append.

Descriptors: *Discharge coefficient, *Floor slot, *Irrigation design, *Outlets, Flow, Channels, Diversion channels, Outlet channels, Model studies, Mathematical studies.

For flow through a transverse rectangular slot located in an open channel floor, the slot width and the characteristics of flow in the approach channel are the important parameters that determine the slot discharge. To determine the relationship that governs the slot discharge, an existing model of the lateral efflux from a two-dimensional channel is used as the basis. Experimental results are presented to validate the proposed relationship. Based on the two dimensional chennel outlet model, a functional relationship between the discharge coefficient, C sub d, and the velocity parameter eta sub 1, is proposed with the slot width to flow depth ratio (L/h sub 1) as the group parameter for the floor slot discharge. The experimental results agree fairly well with the proposed functional relationship in the range 0 <L/h sub 1 < or = 1. (Doria-PTT)
W86-05924

CULVERT SLOPE EFFECTS ON OUTLET SCOUR,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
S. R. Abt, J. F. Ruff, and F. K. Doehring.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 10, p 1363-1367, October 1985, 2 fig, 1 tab, 4 ref.

Descriptors: *Culverts, Slopes, *Scour, *Erosion, *Culvert slope, Sediment transport, Flow velocity, Design criteria, Hydraulics.

Culvert slope is a key parameter in determining the culvert flow velocity and subsequently the discharge capacity and sediment transport capability. Culvert slope may also affect the extent of scour that occurs at a culvert outlet. A circular shaped culvert was tested at 0, 2, 5, 7 and 10% slopes. The scour hole characteristics of depth, width, length, and volume after 316 min of testing were correlated to the discharge intensity. It was determined that a sloped culvert can increase the maximum dimensions of scour from 10 to 40% over the scour dimensions for a horizontal culvert. It is recommended that the existing slope predictions procedures incorporate the effects of culvert slope. (McFarlane-PTT)
W86-05972

CHANNEL WIDTH ADJUSTMENT DURING SCOUR AND FILL,

San Diego State Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2J.
W86-05973

LOCAL SCOUR DOWNSTREAM OF AN APRON,

Victoria Univ. of Manchester (England). Dept. of Civil and Structural Engineering.
N. M. K. N. Hassan, and R. Narayanan.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 11, p 1371-1385, November 1985, 12 fig, 2 tab, 20 ref, append.

Descriptors: *Scour, *Sluices, *Channel erosion, *Jet flow, Structural models, Scour Profiles, Velocity, Froude number, Hydraulics.

Measurements were made of the rate of scour downstream of a rigid apron due to a jet of water issuing through a sluice opening. Experiments were carried out for various sand sizes, sluice openings, efflux velocities, and lengths of apron. Mean velocity profiles in rigid models simulating the shape of the scour hole were studied in detail and exhibited similarity. Scales of velocity and length that were adopted brought together all the data concerning the decay of maximum velocity in the scour hole with respect to streamwise distance. A simple semi-empirical theory based on a characteristic mean velocity in the scour hole is proposed to predict the temporal rate of scour depth for jet walls issuing on a bed of sand. The parameter for dynamic similarity for modeling local scour is the Froude number. (McFarlane-PTT)
W86-05974

ECONOMICS OF PUMPING AND THE UTILIZATION FACTOR,

Melbourne Univ., Parkville (Australia).
B. B. Sharp.
Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 111, No. 11, p 1386-1396, November 1985, 7 fig, 2 append.

Descriptors: *Economics, *Pumping, *Utilization factor, *Water conveyance, *Water costs, Costs, Pipelines, Water mains, Conveyance structures, Design criteria.

The derivative method of determining the optimum (minimum cost) diameter of a force main is

expanded to deal with the economic sizes of any pipeline where pumping is involved. The benefits to be gained from boosting in a gravity main and the notion of a utilization factor provide new approaches for design rules for economic analyses. Five design rules evolved for pipelines where any form of pumping may be appropriate: 1) there is an optimum force main diameter independent of length; 2) a fully utilized force main could mean continuous pumping with two sizes of plant. If the ratio is 4:1 and the smaller plant operates for twice as long, the saving could be >30%; 3) an associated gravity main where there are options for siting the storage should have a diameter not greater than the force main diameter; 4) a gravity main with boosting is more economical when the diameter of the gravity main (no boosting) is >15% larger; and 5) an elevated storage may give a more economical scheme when placed as near the pumping plant as possible (McFarlane-PTT)
W86-05975

STEPPED SPILLWAY HYDRAULIC MODEL INVESTIGATION,
Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W86-05981

FLOOD FORECASTING FOR TUCURUI HYDROELECTRICAL PLANT, BRAZIL,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
S. I. Solomon, E. Basso, C. Osorio, H. Melo de Moraes, and A. Serrano.
Water Resources Bulletin WARBAQ, Vol. 22, No. 2, p 209-217, April 1986. 6 fig, 5 tab, 4 ref.

Descriptors: *Flood forecasting, *Flood recurrence interval, *Tucurui hydroelectric plant, *Brazil, *Cofferdams, *Statistical forecasting models, Dam construction, Data transmission, Satellite technology, Remote sensing.

The construction of the Tucurui Hydroelectric Plant on the Tocantins River basin, Brazil, requires flood forecasting for ensuring the safety of the cofferdam. Initially the cofferdam was designed for a flood with a 25-yr return frequency. Lack of adequate forecasting facilities during construction has resulted in significant damage and construction delays. Statistical forecasting models were developed to prevent further damage at the site. The application of these regression models during the 1980 flood season, when the highest flood on record occurred at the Tucurui site, proved of great assistance in preventing flooding of the cofferdam. In conjunction with development of these models a number of data collection platforms using data transmission through the Geostationary Operational Environmental Satellite were installed to provide automatically the data required for forecasting. (Rochester-PTT)
W86-06015

RUBBLE MOUNDS: HYDRAULIC CONDUCTIVITY EQUATION,
New Orleans Univ., LA. Dept. of Civil Engineering.
A. A. Hannoura, and J. A. McCorquodale.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 111, No. 5, p 783-799, September 1985, 7 fig, 1 tab, 44 ref, 3 append.

Descriptors: *Rubble mounds, *Hydraulic conductivity, *Breakwater, Model studies, Mathematical models, Morrison-type equations, Reynolds Numbers.

The objective of this study was to provide a generalized equation for modeling wave motion in rubble-mound structures, and an outline of the computations required. Experimental investigations were undertaken to develop a generalized hydraulic conductivity equation for rubble mounds which takes into account the inertial force due to the unsteadiness of the flow and the effect of entrained air. Two-phase flow models are used to analyze the air/water flow. A modified Morrison-type equation for the unsteady flow forces is presented. The generalized hydraulic conductivity equation is developed for a wide range of Reynolds numbers. (Author's abstract)
W86-06109

RUBBLE MOUNDS: NUMERICAL MODELING OF WAVE MOTION,
New Orleans Univ., LA. Dept. of Civil Engineering.
A. A. Hannoura, and J. A. McCorquodale.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED5, Vol. 111, No. 5, p 800-816, September 1985, 10 fig, 2 tab, 22 ref, append.

Descriptors: *Rubble mounds, *Wave motion, *Breakwaters, Mathematical studies, Momentum equations, Port Sines.

A mixed numerical model was developed to simulate wave motion in rubble-mound structures. The mixed model utilizes a combined finite difference method of characteristics scheme to integrate the unsteady continuity and momentum equations in the x-t plane to obtain the internal water levels while the two-dimensional properties of the flow are found from a finite element solution for the internal flow domain, x-y plane, at any time t. The two-dimensional solution was used to update pressure distribution coefficient and hydraulic conductivity values in the s-t plane. The model was applied to the Sines breakwater to check the dynamic stability of the seaward slope under severe wave attack. The predicted values for the internal water surface be in fair agreement with a physical model measurement. The model indicates a lower factor of safety than the traditional analysis. Special provisions are included in the model to account for added mass and to detect and correct for internal wave breaking and the entrainment of air near the interface. (Author's abstract)
W86-06110

8C. Hydraulic Machinery

CHARTS FOR WATER HAMMER IN PIPELINES RESULTING FROM VALVE CLOSURE FROM FULL OPENING ONLY,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
B. W. Karney, and E. Ruus.
Canadian Journal of Civil Engineering CJCEB, Vol. 12, No. 2, p 241-264, June 1985. 22 fig, 6 ref.

Descriptors: *Pipe flow, *Valve closure, *Pressure head, *Water hammer, Hydraulic grade line, Uniform closure arrangement, Equal-percentage closure arrangement, Optimum closure arrangement, Parabolic closure arrangement, Graphs.

Maximum pressure head rises, which result from total closure of the valve from an initially fully-open position, were calculated and plotted for the valve end and for the midpoint of a simple pipeline. Uniform, equal-percentage, optimum, and parabolic closure arrangements were analyzed numerically for the maximum pressure head rise at the valve end and at the midpoint of the pipeline. Basic parameters such as pipeline constant, relative closure time, and pipe wall friction were considered with closures from full valve opening only. The graphical results can be used to draw the maximum hydraulic grade line along the pipe with good accuracy for the closure arrangements considered. The equal-percentage closure arrangement yields consistently less pressure head rise than does the parabolic closure arrangement. The optimum closure arrangement yields consistently less head rise than the equal-percentage one. Uniform closure produces pressure head rise that usually lies between those produced by the parabolic and the equal-percentage closure arrangements, except for the range of low pressure head rise combined with low or zero friction, where the rise due to uniform closure approaches that produced by optimum closure. For substantial pipe friction, the pressure head resulting from the parabolic closure can be >10 times the pressure head resulting from the corresponding optimum closure. Pressure head rise at the midpoint is almost >1/2 of the corresponding rise at the valve end and at the quarter point always >1/4 of the corresponding rise at the valve. (Author's abstract)
W86-05468

UPGRADING THE SALEM MUNICIPAL WATER SYSTEM FROM 1914 TO 1984,
Linenthal Eisenberg Anderson, Inc., Boston, MA.
For primary bibliographic entry see Field 5F.
W86-05538

VENTURI AS A SALINE INTRUSION CONTROL FOR SEA OUTFALLS,
Dundee Univ. (Scotland). Dept. of Civil Engineering.
J. A. Charlton.
Institution of Civil Engineers Proceedings PCIEAT, Vol. 79, Part 2, p 697-704, December 1985. 7 fig, 7 ref, appendix.

Descriptors: *Venturi, *Water pollution control, *Saline water intrusion, Outfall, Gages, Measuring instruments, Hydraulic models.

The penetration of sea water into the diffuser system of a sea outfall may induce undesirable malfunctioning and a reduction of hydraulic efficiency. Instead of total prevention of intrusion by valve systems, a method of intrusion control by accelerating the discharge through a Venturi throat is presented. Model tests demonstrated that the Venturi can be used as an intrusion control device, particularly when applied to tunnelled outfalls with questionable purging characteristics. The Venturi, when placed just upstream of the diffuser section, functions as an hydraulic block, and assists the complete purging of sea water even if peak flows have insufficient duration in themselves to achieve this. This control may be situated within the outfall tunnel, or pipe or at the discharge port. (Khumbatta-PTT)
W86-05595

SYMPOSIUM ON PROJECT DESIGN AND INSTALLATION OF SMALL HYDRO POWER PLANTS.
United Nations Industrial Development Organization, Vienna (Austria).
Available from the National Technical Information Service, Springfield, VA. 22161, as DE83-900094, Price codes: A10 in paper copy, A01 in microfiche. Vienna, Austria, June 29-July 1, 1981. Edited by Siegfried Radler. 256 p.

Descriptors: *Information exchange, *Hydroelectric plants, *Design standards, *Installation, Hydroelectric power, Developing countries, Latin America, Hydrologic aspects, Austria.

A number of developing countries in Latin America have established mini-hydroelectric plants and thus have been able to improve their energy supply mainly in rural areas. However, some Latin American countries with abundant potential have not yet begun to develop their hydrological resources, often due to the local absence of the required specialized technical know-how. Austria has long experience in the design and construction of small hydroelectric power plants. Therefore, an exchange of experience in this field between Latin American countries and Austria would be mutually beneficial since much of the practical knowledge on this subject based on actual technical data related to hydrology, design, civil works and equipment of existing small hydropower plants in Austria could be fruitfully applied elsewhere. The main purpose of this publication is to provide suggestions on how the Austrian experience in the mini-hydro power sector could be utilized in developing countries, particularly in Latin America. (See W86-05735 thru W86-05740) (Author's abstract)
W86-05734

SPECIAL REMARKS ON HYDRO POTENTIAL FOR MINI POWER DEVELOPMENTS,
S. Radler.

IN: Symposium on Project Design and Installation of Small Hydro Power Plants, Vienna, Austria, June 29-July 1, 1981. p 21-28, 2 fig, 5 ref.

Descriptors: *Hydroelectric plants, *Electric power production, *Water management, *Available water, Water demand, Catchment basins, Water resources development, Rivers, Streams, Precipitation.

A systematic survey of the hydro power potential is a fundamental condition of a sound power economy in a country like Austria, which meets more than two thirds of its energy requirements from hydro generation. Apart from these general investigations, detailed surveys of the developed and developable potentials have been performed for a great number of river and stream basins as well as for individual federal provinces. Efficient management should be based on an inventory of the available sources and resources. There are various possible ways to determine hydro potential, ranging from estimations covering large regions, to the detailed study of catchments limited as desired. Depending on the surface configuration, the altitude and the hydrological features of the area under investigation, relationships can be established between different methods and information can be obtained on the developable potential. In many cases, especially in catchments on which little information is available, apart from a general idea of the precipitation and evaporation behavior, the precipitation potential will give the better results in the absence of flow data. However, the precipitation potential will not allow conclusions regarding line potential and developable potential unless under certain circumstances such as: 1) where elongated catchments with minor tributaries are concerned, or 2) where major tributaries are treated separately. (See also W86-05734) (Lantz-PTT)
W86-05735

MASTER PLAN FOR HYDRO POWER DEVELOPMENT,
For primary bibliographic entry see Field 6D.
W86-05736

HYDROLOGICAL ANALYSIS FOR THE PLANNING OF SMALL HYDROPOWER PLANTS,
For primary bibliographic entry see Field 2E.
W86-05737

WEIR INSTALLATIONS AND WEIR GATES IN LOW-HEAD POWER SCHEMES,
For primary bibliographic entry see Field 8A.
W86-05738

WATERWAY AND SPECIFIC PROBLEMS OF HIGH-HEAD SCHEMES,
S. Keller.
IN: Symposium on Project Design and Installation of Small Hydro Power Plants, Vienna, Austria, June 29-July 1, 1981. p 137-150, 12 fig.

Descriptors: *Waterways, *Hydroelectric plants, *Turbines, *Jets, Flow rates, Pipes, Water pollution control.

High-head hydro schemes develop relatively small flows under relatively high heads. Such installations will mainly be located at medium and high altitudes, that is to say, in sparsely populated mountainous regions. The preferred power generating machine is the impulse turbine with small jets. This involves special problems relating to desilting and prevention of water contamination as well as to the protection of hydraulic machinery from sand and excessive wear. Possible solutions are presented. Fields of economical application of pressure pipe are defined and suitable types of pipe and raw materials are suggested. Ductile cast-iron pipe lines are discussed in detail. (See also W86-05734) (Author's abstract)
W86-05740

APPLICATION OF STOCHASTIC DYNAMIC PROGRAMMING IN OPTIMIZING THE REGULATION OF HYDROPOWER RESERVOIRS,
Nanjing Hydrological Research Inst. (China).
For primary bibliographic entry see Field 4A.
W86-05780

REGIONALIZATION OF FLOW DURATION CHARACTERISTICS,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W86-05838

STATION EMPLOYS GIANT SUBMERSIBLE PROPELLER PUMPS,
Spotts, Stevens and McCoy, Inc., Wyomissing, PA.
C. M. Jones.
Public Works, Vol. 116, No. 9, p 118-119, September 1985.

Descriptors: *Pumps, *Propellers, Storm-overflow sewers, Storm sewers, Pumping plants, Gravity flow, Reading, Pennsylvania.

The largest stormwater pump station in the United States to use submersible propeller pumps began operation in 1984, in Reading, Pennsylvania. Stormwater runoff in the northeast section of the city often exceeded the capacity of its gravity-flow storm sewers and excess stormwater would periodically flood industries and homes. This discouraged industries from expanding and impeded Reading's developmental progress. After receiving a $4.8 million grant, the city engaged a design engineering firm to design and supervise the construction of an expanded storm sewer system to solve the problem. A high-volume pump station, a 2,000-ft long, 114-inch diameter corrugated steel discharge line, and a new outfall above the flood stage at the Schuylkill River were all installed as a relief system. (Khumbatta-PTT)
W86-05878

FLOOD FORECASTING FOR TUCURUI HYDROELECTRICAL PLANT, BRAZIL,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 8B.
W86-06015

CLEANING NEW PIPING SYSTEMS,
Professional Piping Services, Inc., Land O'Lakes, FL.
R. M. Cimbora.
Public Works PUWOAH, Vol. 117, No. 6, p 92-93, June 1986.

Descriptors: *Pipe cleaning, *Flushing, Suspended material, Chlorination, Pipe flow, *Pipe pigs, Construction.

Foreign materials of various types, including rags, paper, insects, wood, and other construction debris, usually enter piping systems during construction and installation because this is the only time when a system is fully open and subject to this amount of debris. Simply flushing the system, even with full bore flow and at maximum velocity, is only marginally successful and an unacceptable way to clean a system. Cleaning newly installed piping systems can be accomplished easily and simply with a pipe pig. Many varieties are available, some of which are quite sophisticated, but very simple pigs are sufficient for most cleaning operations. The pig collects debris and pushes it out of the system and also puts into suspension material that can be combined with the flow that is pushing the pig. Pigs can be pushed through the system with a hyper-chlorinated slug of water so that a single pass will dispel air, remove debris, and sanitize the system. (Rochester-PTT)
W86-06050

STUDY OF NITROGEN REDUCTION,
Dallas City Water Utilities Dept., TX.
For primary bibliographic entry see Field 5D.
W86-06057

EVAPORATION OF VOLATILE-LIQUID LENSES FLOATING ON AN IMMISCIBLE-LIQUID SURFACE: EFFECTS OF THE SURFACE AGE AND FLUID PURITIES IN N-PENTANE/WATER SYSTEM,
Keio Univ., Yokohama (Japan). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 3A.
W86-06146

8D. Soil Mechanics

USE OF GROUT-FILLED SAUSAGES IN COASTAL STRUCTURES,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
R. Silvester.
Journal of Waterway, Port, Coastal and Ocean Engineering (ASCE) JWPED, Vol. 112, No. 1, p 95-114, January 1986. 12 fig, 1 tab, 22 ref.

Descriptors: *Shore protection, *Mortar, *Grout-filled sausages, *Cost analysis, Marinas, Breakwaters, Rubble mounds, Precast concrete armor, Construction.

A recommended alternative to rubble mound construction, with or without precast concrete armor units, comprises flexible membranes filled with cement mortar in situ. The placement of these for greatest stability is suggested by maximizing surface contact of sausage type units. Sausage units laid trellis fashion across the structure distribution forces along each, thus minimizing the effects of wave action. Spacing the sausage units at mid-depth reduces the forces on them. Results of tests to derive an economical mortar mix are described. Costs of structures using sausage-type units can be less than for the rubble-mound alternative. Because of the great variety of sizes possible these armor units are applicable to all types of marine structures, such as breakwater, graynes, and headlands. (Rochester-PTT)
W86-05503

RE-EXAMINATION OF SLIDE OF LOWER SAN FERNANDO DAM,
Geotechnical Engineers, Inc., Winchester, MA.
G. Castro, S. J. Poulos, and F. D. Leathers.
Journal of Geotechnical Engineering (ASCE) JGENDZ, Vol. 111, No. 9, p 1093-1107, September 1985. 6 fig, 2 tab, 11 ref, 2 append.

Descriptors: *Dam failure, *Liquefaction, *Steady-state strength, *Flow slide stability analysis, *Lower San Fernando Dam, *Earthquakes, *Soil mechanics, *Landslides, California, Seismic shear stresses, Loose sandy soils, Laboratory tests, Earthquake engineering.

Previous analysis of the major slide that occurred in the upstream slope of the Lower San Fernando Dam (California) following the earthquake of February 9, 1971, have been based on evaluation of seismic shear stresses and the results of cyclic triaxial tests. These previous analyses fail to explain several key features of the slide. The reanalysis presented here, which is based on the concepts of liquefaction, steady-state strength, and flow slide stability analysis, and on the data obtained during the previous analyses, is consistent with the features of the observed slide. The estimated in situ undrained steady-state strength is substantially lower than the undrained strength measured in conventional laboratory tests due to the sample densification that normally occurs during sampling, handling, setup, and consolidation of loose sandy solis. An interpretation of the limited data on undrained strength available for the San Fernando Dam indicates that the soils that liquefied had very low undrained steady-state strengths. (Author's Abstract)
W86-05555

MOISTURE CURVE OF COMPACTED CLAY; MERCURY INTRUSION METHOD,

Purdue Univ., Lafayette, IN.
S. Prapaharan, A. G. Altschaeffl, and B. J. Dempsey.
Journal of Geotechnical Engineering (ASCE) JGENDZ, Vol. 111, No. 9, p 1139-1143, September 1985. 3 fig, 9 ref.

Descriptors: *Soil moisture characteristic curve, *Mercury intrusion method, *Compacted clay soils, *Pore size, Illinois, Soil water, Paving, Soil engineering.

Mercury intrusion procedures were used to obtain soil moisture characteristic curves for compacted clay soils from various places in Illinois and the results were compared with curves obtained by the conventional method. The soil moisture characteristic curve as predicted is equivalent to the desorption curve because mercury has a contact angle greater than 90 deg and the injection of mercury into the pores is similar to ejection of water from the pores. Mercury intrusion procedures and the pore-size distribution of soil can be used to determine the soil moisture characteristic curve that is valid for suctions in excess of 500 cm of water. Such determinations appear to be adequate for most practical purposes for pavement subgrade soils and determining their equilibrium water contents. (Rochester-PTT)
W86-05556

DYNAMIC SOIL AND WATER PRESSURES OF SUBMERGED SOILS,
Nagoya Univ. (Japan). Dept. of Geotechnical Engineering.
H. Matsuzawa, I. Ishibashi, and M. Kawamura.
Journal of Geotechnical Engineering (ASCE) JGENDZ, Vol. 111, No. 9, p 1161-1176, September 1985. 11 fig, 2 tab, 19 ref.

Descriptors: *Submerged backfill soils, *Dynamic soil and water pressures, *Apparent angle of seismic coefficient, *Soil permeability, *Soil geometry, *Wall movement, Soil engineering, Retaining walls, Theoretical analysis.

Current theories and procedures in evaluating dynamic lateral earth and water pressures due to submerged backfill soils against rigid retaining structures are thoroughly reviewed. Available experimental data is gathered and compared to the theories. A new generalized apparent single angle of seismic coefficient, which can be easily used to evaluate dynamic soils as well as water pressure for which a wide range of backfill soil types, is proposed. The new procedure incorporates the effects of the permeability and the geometry of the backfill soils and the modes of the wall movement. (Author's Abstract)
W86-05557

SEEPAGE BENEATH A CONCRETE DAM WITH A DOWNSTREAM FILTER,
Alexandria Univ. (Egypt). Faculty of Engineering.
H. M. Hathoot.
Applied Mathematical Modelling AMMODL, Vol. 10, No. 2, p 129-132, April 1986. 4 fig, 10 ref.

Descriptors: *Seepage, *Concrete dams, *Downstream filters, *Soil, *Schwartz-Christoffel transformation, Filter length.

A study is presented on the seepage occurring through homogeneous soil beneath a concrete dam with a downstream filter and taking into account the existence of a lower horizontal impervious sublayer. The problem is hydrodynamically solved by using the Schwartz-Christoffel transformation and a seepage formula is presented. A study on a non-dimensional graphical representation of the seepage formula led to the prediction of the recommended lengths of downstream filters. In addition, a formula for evaluating the uplift pressure distribution on the base of the dam is presented. Examination of the pressure distribution formula shows that two important boundary conditions are satisfied. (Author's abstract)
W86-06078

8F. Concrete

CONCRETE WATER TANKS IN ONTARIO,
Slater (W.M.) and Associates, Inc., Toronto (Ontario).
W. M. Slater.
Canadian Journal of Civil Engineering CJCEB, Vol. 12, No. 2, p 325-333, June 1985. 2 fig, 5 tab, 37 ref.

Descriptors: *Concrete water tanks, *Ontario, *Failures, *Cold regions, Construction methods, Canada, Thermal gradients, Shrinkage stress, Tensile stress, Ice formation, Design standards.

Since 1981, an Ontario (Canada) provincial government study has been undertaken on 53 water tanks built since 1956. Results of mainly external, but some internal inspections, condition surveys, and ratings using an ascending 0-9 scale revealed a wide range of performance, varying from failed tanks, rated 0 (2 tanks), to very good performance (rated 9. The ratings generally were related to the tank types and construction method used. The best performance was exhibited by posttensioned bonded types. Problems and causes of failure identified varied from specific construction methodology faults, such as slipform jack rods (pipes) left in the walls of certain types of tank, which filled with water and froze, to common defects, such as cold joints, experienced in all types, leading to leakage and freezing, and ice expansion in voids in tank walls during the winter. Actual concrete tensile stresses induced by internal ice formations, thermal gradients, and shrinkage stresses were found to be higher than those used in most designs or allowed in international codes and standards. As a result of the present study, a provincial government rehabilitation program for ministry-built tanks in need of repairs and leakproofing was started in mid-1982. (Author's abstract)
W86-05472

SEEPAGE BENEATH A CONCRETE DAM WITH A DOWNSTREAM FILTER,
Alexandria Univ. (Egypt). Faculty of Engineering.
For primary bibliographic entry see Field 8D.
W86-06078

8G. Materials

ANGULARITY OF AGGREGATE PARTICLES AS A MEASURE OF THEIR SHAPE AND HYDRAULIC RESISTANCE,
Aligarh Muslim Univ. (India).
R. D. Gupta.
Institution of Civil Engineers Proceedings PCIEAT, Vol. 79, Part 2, p 705-716, December 1985. 10 fig, 1 tab, 28 ref.

Descriptors: *Angularity, *Particle size, *Particle shape, *Hydraulic properties, Soil aggregates, Resistance, Limestone, Quartzite, Gravel, Mathematical equations, Mathematical studies.

The angularity of naturally-occurring and crushed aggregates is used to measure their hydraulic resistance to seepage in the non-Darcy regime. The relationship between the angularity and the size of particles for materials of different shapes was also investigated. Extensive experimental results of angularity number tests on various sizes of different materials and their mixtures in different proportions produces an equation connecting the angularity with the size of the material. This involves a factor C which depends on the shape of the particles. The values of factor C for particles of different shapes of uniform size are correlated with their corresponding friction factors at different values of the Reynolds number. Limestone, crushed quartzite, rounded gravel and mixtures of different proportions of limestone and rounded gravel are the materials used in this study. Results indicate that: 1) the angularity of the irregular shaped particles increases with a decrease in the size of the particles; 2) for irregular shapes, where all the particles belong to the same shape group, the angularity of the particles can be used as a measure of their hydraulic resistance; 3) for mixtures of different shaped particles, the relationships between the friction factor and shape factor C is different from that for individual shapes of particles; and 4) for all mixtures studied, the observed values of friction factor were lower than they would have been had the same laws, as for samples of individual shapes, been applicable to mixtures. (Khumbatta-PTT)
W86-05596

FEASIBILITY OF NYLON AND POLYVINYLIDENEFLUORIDE MEMBRANE FILTERS AND MATERIALS FOR THE CONSTRUCTION OF SUCTION CUPS (EIGNUNG VON NYLON- UND POLYVINYLIDENFLUORIDMEMBRANFILTERN ALS MATERIALIEN ZUM BAU VON SAUGKERZEN),
Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Hydrogeologie und Hydrochemie.
J. Grossmann, G. Freitag, and B. Merkel.
Zeitschrift fuer Wasser- und Abwasser Forschung ZWABAO, Vol. 18, No. 4, p 187-194, August 1985. 2 fig, 2 tab, 8 ref.

Descriptors: *Suction cups, *Materials engineering, *Lysimiters, *Sampling, Soil water quality, Hydraulic properties, Chemical properties, Seepage, Lead, Copper.

Suction cups are used to extract seepage water from the unsaturated zone. Those types being used now which are made of aluminum oxide sinter or ceramics present a number of disadvantages due to their relatively high exchange capacity, especially with regard to substances in low concentration in the seepage water. This complicates the measurement of short-term concentration fluctuations and the examination of transport mechanisms. Filter membranes made of nylon and polyvinylidene fluoride in combination with a polyethylene sinter possess the required hydraulic and chemical attributes to replace the aluminum oxide materials. Substances dissolved in seepage water are adsorbed on a much smaller scale by plastic membranes than by the aluminum oxide sinter. These advantages are particularly noticeable with respect to such elements as lead or copper. (Author's abstract)
W86-05821

8I. Fisheries Engineering

ATTEMPTS TO RECONCILE CONFLICTING DEMANDS OVER COLUMBIA RIVER OUTPUTS,
Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W86-05788

SPATIAL AND TEMPORAL CHANGES OF NITRIFYING BACTERIAL POPULATIONS IN FISH PONDS OF DIFFERING MANAGEMENT PRACTICES,
Kalyani Univ. (India). Dept. of Zoology.
For primary bibliographic entry see Field 5G.
W86-05833

REHABILITATION OF A TROUT STREAM,
Harza Engineering Co., Chicago, IL.
D. B. Pott, and D. Schellhaass.
Public Works PUWOAH, Vol. 117, No. 6, p 90-93, June 1986.

Descriptors: *Trout, *Stream improvement, *Habitat structures, *Illinois, Piscasaw Creek, Stocking, Public participation, Conservation districts, Recapture census, Creel census.

Development of trout habitat on Piscasaw Creek, near Harvard, Illinois, is described. The project history, preliminary habitat assessment, construction of habitat structures, and stocking program are described. The project has benefited from public, private, and civic cooperation involving Illinois Department of Conservation, the McHenry County Conservation District, the Youth Conservation Corps, Boy Scouts, Trout Unlimited, and Harza Engineering Company. A semi-annual

stocking program has been conducted for 2 yr with brown and rainbow trout. Recapture studies and creel census will be employed to assess the success of the stocking effort. (Rochester-PTT)
W86-06049

EFFECTS OF SALMINCOLA CALIFORNIENSIS (COPEPODA: LERNAEOPODIDAE) ON THE GILLS OF FARM-RAISED RAINBOW TROUT, SALMO GAIRDNERI,
Wisconsin Univ.-Madison. Dept. of Veterinary Science.
D. R. Sutherland, and D. D. Wittrock.
Canadian Journal of Zoology CJZOAG, Vol. 63, No. 12, p 2893-2901, December 1985. 16 fig, 2 tab, 11 ref. NOAA Grant No. NA844AA-00065.

Descriptors: *Parasites, *Copepods, *Trout, *Gills, *Fish farming, Dissolved oxygen, Mortality, Synergistic effects, Iowa.

Salmo gairdneri from an Iowa trout farm were found to be infested with Salmincola californiensis. Examination of gills from 235 trout revealed a prevalence of 83% and a mean intensity of 4.6 copepods. Preferred sites were established with the adult female attached usually on distal ends of the gill filaments or on gill bars and the chalimus attached to proximal regions of gill filaments. Examination of hematoxylin and eosin stained tissue sections of attached adult females revealed hyperplasia and hypertrophy ('tumor of attachment') and atrophy or growth inhibition ('crypting') of affected gill filaments. Eosinophilia and absence of mucous cells occurred in gill filaments affected by feeding activities and bulla attachment. Hyperplasia of the gill filament cartilaginous rod and resulting formation of a cartilaginous 'bridge' between bulla and filament rod is described. Chalimus attachment elicited hyperplasia and frequently fusion of basal elements of adjacent gill filaments. Activities of adult females attached to gill bars resulted in proliferation of stratified squamous epithelium, infiltration of granular leucocytes and reduction of mucous cells. Damage to gill tissues of trout maintained in dense populations of fish culture is deemed significant, especially during summer periods of low dissolved oxygen. (Author's abstract)
W86-06125

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

HYDROGEOLOGICAL TRAINING IN THE USSR,
E. Zaltsberg.
Ground Water GRWAAP, Vol. 24, No. 4, p 460-465, July-August 1986. 1 tab, 3 ref, append.

Descriptors: *Geohydrology, *Soviet Union, *Training, Education.

This is a short description of undergraduate and graduate hydrogeological training in Soviet universities. The undergraduate training of hydrogeologists in the USSR has certain merits. This training, as any other university education in the USSR, is free of charge and available in many Soviet universities and institutes for every student who has graduated from a secondary school. Moreover, many students are provided with financial support from the government in the form of monthly stipends which usually account for 25-30% of the junior engineer's salary. Undergraduate training provides extensive and solid knowledge both in fundamental sciences and hydrogeological disciplines. At the same time, one of the demerits of this training is its academic rather than practical orientation. As a result, many students are not familiar enough with practical approaches in the solving of certain hydrogeological problems. The ordinary Soviet undergraduate student is less familiar with modern computer techniques and programming than his American counterpart. The general level of advanced degree research in the field of hydrogeology is approximately the same in the USSR and USA. However, American researchers use computers and sophisticated measurement equipment more widely than their Soviet colleagues. On the other hand, while American hydrogeological research mostly concentrates upon particular problems at particular sites, Soviet researchers carry out not only applied research, but also a lot of basic research in the fields of regional, global, and even planetary hydrogeology. (Lantz-PTT)
W86-06169

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

ALABAMA COASTAL REGION ECOLOGICAL CHARACTERIZATION; VOLUME 1, COASTAL BIBLIOGRAPHY,
Geological Survey of Alabama, University.
For primary bibliographic entry see Field 2L.
W86-05748

10F. Preparation Of Reviews

STATE OF THE ART REVIEW: THEORIES AND APPLICATIONS OF SYSTEMS ANALYSIS TECHNIQUES TO THE OPTIMAL MANAGEMENT AND OPERATION OF A RESERVOIR SYSTEM,
California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 6A.
W86-05790

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